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Ratio of Telephones to Population.

In view of the rapid development of telephony during recent years in this country, the question has been raised whether the business is not already overdone. But a study of the statistics soon reveals the fact that nothing justifies such a fear. On the contrary, the ratio of telephones to the whole population of the United States is much smaller than it might be, even on the basis of existing possibilities. There are probably to-day in connection with exchanges in this country, from 750,000 to 800,000 subscribers, of whom about 475,000 are on the Bell system. This gives a proportion of, say, 1 to every 100 people, which is about the ratio for New York City. But in the Boston Bell system, the ratio runs about 1 in 60, while in Sweden and Norway it runs as high as 1 in 25. At the Boston figure, there should now be 1,250,000 subscribers in America, and at the Swedish figure not less than 3,000,000.

Something For Nothing.

Mr. Tom Johnson has long been a conspicuous and picturesque figure in the development of electric traction, and it has been interesting to follow his movements and utterances in that branch of industry, not less than in politics and social economics. His industrial views have often struck us as sound and to the point, but when he intermingles new socialism with old business experience, we fail to follow him. For example, he has just promised the public a good time coming, just as the old song does, "when the people will ride free upon the street cars owned and operated by the municipality, the same as they now get their letters delivered to them by the postal system." Was there ever such a delusive comparison? Mr. Johnson pays 2 cents for every letter he sends through the mails, even from one part of a small city to the other parts, and so does everybody else. The charge is preposterously outrageous when we compare it with the low fare that Mr. Johnson has charged on his electric lines for carrying anywhere from 150 to 250 pounds of humanity anywhere from 5 to 15 miles. The electric street cars under private management give infinitely better and cheaper service to the public than do the government mails. Of course, a municipality can own street car lines and run them without charging fares, but they would not be "free." Somebody must foot the bill.

The Rare Oxides and Incandescent Lamps.

It has frequently been asserted that as the high economy of the Welsbach mantles is due to the use of the rare oxides of the alkaline earths, a similar application of these oxides to the filament of the incandescent lamp would enhance the economy of the latter. The correctness of this deduction depends entirely on the particular properties of these oxides through which they increase the light. If it is merely that they can stand a higher temperature than other materials, then it would be necessary to make the whole filament of them, and if they can be made conducting by heat, it would simply be a sort of Nernst lamp. If they have a peculiar property of changing heat into light, coating carbon filaments with them might lead to very good results.

It seems to have been shown, however, that the rare oxides do not have this latter valuable property, and that their action is primarily to facilitate combustion in the pores of the mantle, which in turn increases the temperature immediately around the fibres of the mantle to a higher degree than is possible with the Bunsen flame alone. This has recently been shown by a French scientist, Bunte, who found that the oxide of cerium lowers the temperature of combustion of oxygen and hydrogen from 650 to 350 degrees C., thereby increasing the activity of the combustion which raises the temperature. If this is the case, and we have no reason to doubt it, it seems useless to expect to get any improvement in the incandescent electric lamp by the use of these oxides as coatings of the filaments. The experiment has, we believe, been tried repeatedly without favorable results, and it would therefore appear that any improvement in the incandescent lamp filament should be looked for in other directions.

TRADE SUBSTITUTION AND IMITATION.

One of the vexed questions of industrial manufacture for a long time past has been that of "substitution," a word by which is meant the offering of some inferior article by the storekeeper to the purchaser who has inquired for a well-known, well-advertised specialty. The practice has been developed on the grand scale and is said to result yearly in heavy loss to the legitimate manufacturer as well as to the deceived purchaser. Even in minor trade, the dealer will often offer something of his own, made up to resemble a popular brand. Various steps have been taken to check the evil, with more or less success.

A somewhat different proposition is presented in cases where standard articles long familiar are made by everybody or are described by everybody under a name which once was distinct and separate as applied to the specialty. For example, there are electric "hansoms" and "broughams" to-day, and those words even under the newest conditions mean just the same as they did when the two types of carriage were introduced to public notice. If, again, the word "telephone" could be, or had been protected, it might make a good deal of difference to the independent manufacturers who now swarm so thickly all over the country.

That priority and pioneership in these matters have some vested rights, however, is shown by a recent remarkable New York decision in the case of a medical battery. So far as we are informed, this piece of apparatus was never patented or copyrighted, but the court has now protected the pioneer makers of it from competition by imitations of it. The type had become standard, and it is obvious that under the conditions a rival of the original manufacturers might well and honestly claim that he infringed no one's legal rights, even if he made a Chinese copy of the apparatus. The judge, however, sees in the facts of the case full warrant for interposing the protection of a broad kind of equity, which might well be carried further. We know of no precedent to this decision in the electrical industry.

THE TELELECTROSCOPE A NECESSITY.

One of the most annoying idiosyncracies of inventors is their tendency to tell us how easy it is to give the world some invention that is badly needed and then to linger so long over its production that whole generations of men go to their grave deploring its non-appearance. In an age of many marvels, it is not reasonable, perhaps, to complain very harshly on this score, but the child that has been promised a new toy always wants it keenly; and the daily course of events in human life often shows how much good might be done, or evil prevented, by an invention still to be though long since promised.

In the early days of the telegraph, such incidents were reported as hanging a pair of boots on the wires for transmission, and the public fancy cherishes yet the idea of electric transportation of that kind. Not long ago, the "portelectric" system undertook to gratify the wish, but the old express wagons jog along, and it is whispered that even engagement rings cannot yet be sent by cable across sea, but require district messengers. It is a long time since the "telelectroscope" was promised, but the only prospect of getting it is vaguely associated with the Paris Exposition of 1900.

Meantime, a sad breach-of-promise suit has occurred in Nebraska just for lack of this one invention. To get married by telegraph is a hackneyed thing, but to get married by telephone or to make love through it is more recent and novel. Out in Nebraska two soft-hearted people, employed in two offices on a telephone toll line, fell in love with each other at long distance. She seems to have liked him for himself, as a man, and he became enamored of her "beautiful, flute-like voice." They did not exchange photographs, but she allowed her age was only nineteen. When after becoming engaged over the wire, they met at last, he found her to be a "raw-boned old woman" of thirty-five. He broke it off instanter, whereupon she has brought suit for $5000 damages. Women apparently become old and raw-boned quite early in Nebraska, but just see how much misery the telelectroscope would have saved. A sad story like this should be a sharp thorn in the inventor's pillow, or caution him to be more moderate in his imaginings.

THE METRIC SYSTEM OF WEIGHTS AND MEASURES.

We are so accustomed to pride ourselves upon our *fin-de-siècle* receptiveness, and upon the readiness with which we eliminate the useless and the superstitious from the true, that it is only when we come to analyze some of our most cherished customs that we find how potent a factor is conservatism in determining our tendencies, and how all-pervading is the power of habit, even when opposed to simplicity and usefulness. A striking example of this kind is to be found in the system of weights and measures in use and in course of education in this country and in all English-speaking countries at the present time. It must be patent to everyone who calmly and dispassionately reviews our current tables of weights and measures that they are heterogeneous, ambiguous, incoherent and burdensome to the memory. It is most rarely that any man or woman in the community, excepting professed teachers of the subject, has the various tables of weights, lengths, volumes and areas so completely within the grasp of memory as to be able to reproduce them without the aid of a book. Many persons who pass for being well educated, live and die in the belief that the pound avoirdupois is the same as the pound Troy, or that the United States gallon is the same as the British gallon, or that a bushel has but one voluminal value. It is terrible to think of the waste of labor in teaching so barbarous a system, of the ambiguity in using it and of the labor in performing computations with it. The advantage of the metric system of weights and measures over the ordinary heterogeneous English systems of weights and measures is as manifold and as marked as is the advantage of the dollar and cent or decimal system of coinage over the old English penny, shilling, crown, sovereign and guinea. No better evidence of the force of habit could be adduced than that which conserves so ridiculously complex and unwieldy a system in such extensive use.

The opponents of the metric system argue that a change to the metric system would involve nothing less than chaos and panic in mechanical construction, seeing how many thousands of tools and patterns are in use based upon the measure of the English foot or inch. This, however, is not an argument against the change, but only against a sudden change. Nothing, indeed, could be more dis-

astrous and injurious than a sudden change to the metric system. It would be immensely costly, and bad as the present system is, its continued use is preferable to such a penalty for rash reform. There is, however, no necessity for such extravagance. Tools do not last forever, and all things change. It would only be necessary to ordain by legislation that all government contracts, after the lapse of a certain time, say one or two years, should be based solely upon the metric system, and the change would probably come about so smoothly and gradually under the influence of this stimulus, that in the course of ten or twenty years the present tangle would probably be forgotten.

The tangle is, perhaps, more twisted and contorted in the business of dynamo design than in any other, for the reason that the electrical and magnetic units of the C. G. S. system are very simple and easy to remember. We have no such ridiculous ratios in the C. G. S. system, as, for example, 437.5 grains in an ounce avoirdupois, or 231 cubic inches in the United States gallon. Nevertheless, in order to deal with dynamos as actually constructed in the shops, it is the almost universal practice to employ hybrid units connecting the C. G. S. measures with the English measures in a manner which, while quite clear and definite to those who are accustomed to it, requires extra labor to learn and extra labor to compute, nor is there apparently any hope of simplification so long as the old tangle persists.

THE SINE-CURVE AND ALTERNATING CURRENTS.

Nothing has tended to surround the subject of alternating currents with so much mystery as the application to its phenomena of the nomenclature of the sine curve. One not versed in the mathematics of the sine curve, or unacquainted with the relation of its properties with alternating-current variations, must necessarily be perplexed in reading of an angle of lag between a current and an e. m. f., for such a physical relation is unthinkable. Even those who are well acquainted with the mathematical theory of alternating currents are apt to be hazy as to the distinction between sine-curve properties and alternating-current phenomena. All of this arises from writers and teachers usually not dwelling upon the fact that the use of the sine curve in alternating-current calculations is a mere artifice to simplify such calculations, and also through their confounding mathematical abstractions with physical phenomena.

There is only one chance in infinity that an alternator will generate a current whose variations may be exactly expressed by the sine law. It happens for several reasons that an alternating current following such a law is in most cases the ideal one for practical use, but this did not become generally known until after the entire fabric of sine-cuvre alternating-current theory had been woven. The origin of this theory goes back to Joubert's celebrated experiments in 1881, which by chance were made with an alternator that generated e. m. f.'s approaching the sine law in their variation. Since then an harmonic variation of e. m. f. and current has been assumed, and the consideration of alternating currents has been frequently made a branch of mathematics, entirely ignoring the physical basis of the phenomena under treatment. Let it be said now that it is extremely fortunate we can base alternating-current calculations upon such a simple relation as that expressed by the sine law, for otherwise such calculations would be almost impossible. Nevertheless, we should not lose sight of the fact that this law as mathematically applied is an artifice which tends to conceal rather than disclose the physical nature of the phenomena submitted to its processes.

Let us see why angles, vector arithmetic, phase relations, etc., enter into alternating-current formulas. Suppose an alternating current is flowing in a circuit having resistance but not inductance. As the current rises and falls, the ohmic drop, being the product of the current and resistance, rises and falls in time with the current—that is, in phase with the current. Moreover, there being only resistance to overcome in the circuit, this drop must be equal to the impressed e. m. f., or the current and impressed e. m. f. are in phase—that is, have their maximum and minimum and all corresponding values at the same instant, respectively. Now, suppose that in addtion to resistance there is inductance in circuit—for example, a coil. As the current rises and falls, the coil at one instant has a larger or smaller number of lines of force due to the current than at another instant. Whatever may actually occur, the effect is as if the number of lines represented by the difference cuts into or out of the turns of the coil, thereby setting up an e. m. f., which opposes the current when the latter is rising, and aids it when falling. But since in a given time the current changes value most rapidly when passing through zero, and least rapidly when passing through its maximum or minimum, the inductive e. m. f. is a maximum when the current is at zero, and has a zero value when the current has its maximum or minimum value. In other words, there is a difference in phase between the current and the inductive e. m. f. due to it, equivalent to the time required to pass from zero to a maximum value, which is also equivalent to a half alternation or to a quarter period.

Now, if we know the form of the variation of the current and e. m. f., we can plot the curve of ohmic drop, which is in phase with the current, and the curve of inductive drop, which, since it is a half-alternation out of phase with the current, must be out of phase the same amount with the ohmic drop. Then by addition and subtraction of simultaneous ordinates of these two curves, we get a third curve whose ordinates are the algebraic sum of the ordinates of the component curves and must represent the entire e. m. f. acting on the coil—that is, the impressed e. m. f. But in practice we could not obtain the form of variation necessary for this method without laborious laboratory experiments on the machine used. The first step is then to assume a standard for mof variation, and for this, as stated before, the sine curve offers an ideal standard. But even to lay down sine curves for each operation would be extremely laborious, while the results would be apt to be inaccurate. The next step then is to abstract the relations of the physical phenomena and apply to them the mathematical processes of the sine-curve law. In so doing, however, we pass away from the simple addition and subtraction which physically apply in alternating as in direct currents, to vector addition and subtraction; and from simple and rational phase relations to trigonometrical angles. In return, the labor of calculation is enormously simplified, relations between quantities take care of themselves, and the accuracy is the greatest attainable.

Having, however, once obtained the results sought, there is a final step, and it is from this rarely being taken, that all of the muddle in the understanding of alternating currents arises. Physical conceptions were left behind in going from the alternating-current phenomena to the sine curve, and the results arrived at have no physical meaning after they have been attained until this step is retraced. The angle of the sine curve must be conceived of as a time—the time between reaching the zero or other corresponding value, of the current and impressed e. m. f., which obviously may also be expressed as a fraction of a period or of an alternation. That is to say, if we do not wish to get confused, we should leave behind the triangles, forces acting at angles to each other, lag and other angles, vector arithmetic and all the mathematical properties of the sine curve, and think of the results in their natural relation with the phenomena considered. This relation is, moreover, as simple for alternating currents as for direct currents if we view inductive and capacity e. m. f. as analogous to motor counter-e. m. f.

Metropolitan Will Not Build New York Underground.

William C. Whitney and his associate capitalists in the Metropolitan Street Railway syndicate decided on April 17, after a conference with the Rapid Transit Commission, to withdraw their proposal to construct an underground rapid transit railroad. This determination was reached because of the opposition that has developed to the terms of the proposal. At the time the proposal was submitted to the Rapid Transit Board both Mr. Whitney and President Vreeland said that if any considerable public sentiment should develop against the terms proposed the proposal would be withdrawn.

The numerous objections recently urged against granting an underground railway franchise to any corporation without compensation to the city, and also against granting such a franchise in perpetuity, convinced Mr. Whitney and his associates that the arrangement proposed by them could not be carried out without a hard fight. Mr. Whitney declared that his friends and himself had no idea of fighting for the franchise, and they would not be placed in such a position.

Mr. Croker Under Investigation.

The Mazet investigation committee of the New York Legislature, had Mr. Croker before it as a witness, last week, under examination by Mr. Moss, who hinted at several little transactions which he may or may not be able to trace directly to Mr. Croker. For instance, he referred to the project to John Jacob Astor and others to form a new telephone company and reduce telephone rates. Having asked the witness if a representative of Mr. Astor had called to see him about this company, and having been told that such might have been the case, Mr. Moss asked if it was not a fact that Mr. Croker had refused to give his favor to the new telephone company, because he had been "seen" by representatives of the New York Telephone Company. Mr. Croker denied this and then Mr. Moss wanted to know if the witness had not made an agreement with Mr. Charles F. Cutler, president of the New York Telephone Company, to show a special favor to the latter company for a period of five years in consideration of a certain fixed sum of money to be paid to Croker annually. The witness denied this, but the asking of the question created something of a sensation in the courtroom. He also sought to prove that Mr. Croker received half of one of Mr Bourke Cockran's legal fees in a case in which action on street railway work for the Metropolitan Company by the Board of Aldermen was requisite. He didn't get much light on this from Mr. Croker, who hesitated, denied, and then "didn't remember."

Mr. Croker testified also that he didn't know that the city departments had begun to raid the Manhattan Elevated Railroad because it would not let his Auto-Truck Company string compressed-air pipes on its structure; and in fact he seemed at one time to be under the impression that he could show that the pipes were only to supply the railroad with air power for side uses. He produced a letter from Mr. Skitt accepting such an offer subject to proper engineering tests; but he added later that his company, in addition to anything set forth in Mr. Skitt's letter, proposed to supply its trucks from the same pipes.

Adverse Report on a Municipal Plant for Springfield, Mass.

During the past winter the committee on street lighting, of the city of Springfield, Mass., was made a special committee on the subject of a municipal plant for electric lighting, and began to collect data. Having made a very careful and thorough investigation on the subject, they filed a report, which has now been issued in the annual Municipal Register of the city, a copy of which has been forwarded to us. The committee advised against a plant. Part of their report runs as follows:

"We found the answers received from municipal plants very unsatisfactory, and we must say, in some cases, inaccurate, as the answers received from one city were very different on the two circulars sent, and we are advised that on four requests for information similar to our own, no two were alike. This arises principally from the way in which the cost is figured, but the result is very unsatisfactory and misleading.

"After closely comparing the tables of the private and the municipal plants we found that the only true way to compare the two was to find out the candle-power received for one cent, and the attached tables show the result. There are several items that must be considered before deciding the matter on the figures received. One, and a very important one, is the cost of coal; of the cities giving this information, we have found that eleven private plants paid more than 50 per cent. more than the eleven municipal plants. This factor alone would more than make up the difference in cost per candle power. Another important factor is labor, and while we have no official figures from private information, we are advised that that also is much higher. Another item is the fact that only a very few of the municipal plants have made any allowance for depreciation and those that have, allow only from one to 5 per cent., which is far below that allowed by most private plants. Only six of the plants allow anything for interest on money invested, while ten do not. It must be remembered in comparing the two tables that only one of the municipal plants was purchased by the city; all the others are comparatively new plants recently equipped, thus doing away with all repairs and obsolete machinery.

"If Springfield should decide to establish its own electric light plant it would be necessary, under the laws of the state, and under our contract, to purchase of the Electric Light Company their present plant, with its large amount of obsolete machinery, comparatively worthless. This would mean a loss in taxes to the city of over $5,000, as this company was taxed in 1898, $5,408.22. Owing to the large amount of money that the city would have to pay for the purchase of the plant and to the large depreciation on electrical machinery, together with the fact that the city will be in position next spring to make a very favorable contract with the electric light company, your committee is of the opinion that it is not advisable at this time to enter into such an undertaking."

Yesterday and To-day in Arc Lighting.

A very interesting review and discussion of the development of electric street lighting was given by Mr. Albert Sheible before the Chicago Electrical Association recently. Much of the matter was historical and reminiscent, dating back to the days of the Jablochkoff candle and the time when people went to see the Brush arcs on the Public Square in Cleveland carrying dark glasses with them. Speaking of lamp distribution as practiced to-day Mr. Sheible said: "The distribution of lamps in a town, while still affected by the political influence of adjoining residents, is no longer done entirely in accordance with the clamor of the local constituents. The question used to be, where shall we put a certain number of lights? Now it is, where do we need the lights, and how shall we support them to avoid deep shadows? One recent installation had 14 per cent. of the arc lamps on mast-arms, 25 per cent. on short pole brackets, 60 per cent. on cross-suspension wires and 1 per cent. on pole tops. Even in this case many of the cross-suspension arcs might better have been replaced by four or five times as many incandescents, as is now frequently done." He went on to remark that the rebate system for outages had helped to secure reliability of service, and made some pertinent criticisms on the continuing ugliness of the average standard arc light poles and fixtures. He summed up the growth of twenty years as follows:

Yesterday, the cry was for large lamps and intense illumination of some picked spots, regardless of the equally intense shadows intervening. To-day, there is the tendency to have the rays of light overlap and to use lower candle-power lamps in the alleyways and other dark nooks and on the streets of the outlying districts. To-morrow, we may look for smaller units and a great many more of them.

Yesterday, the lower efficiency of the incandescent lamp kept it back. To-day, our ability to distribute light more uniformly with the incandescents has caused them to be used in many places, and to-morrow we may look for small arcs or incandescents of higher temperature (and therefore higher efficiency) to bridge the gap.

Yesterday the naked arc, being all the more dazzling, was welcome. To-day enclosing globes are mellowing the effect on the eye, To-morrow the use of naked arcs out of doors and less than, say thirty feet above the ground, ought to be prohibited by law.

Yesterday every circuit of one or two dozen arc lamps required its own generator. To-day we have from 100 to 200 run from a single generator, and to-morrow we may have four or five hundred arcs (or the equivalent of part of them in incandescents) all run from the same alternator.

Lewiston, Idaho, Long Distance Transmission.

DURING the summer of 1897, while the writer was engaged in a water-power survey of the State of Washington, his attention was called to Asotin Creek as a source of power. Asotin Creek is a tributary of the mighty Snake River and empties into the river at Asotin City, five miles above Lewiston, Idaho. The creek has a mean annual flow of about 200 cubic feet per second, and is a continuous series of cascades. The average fall per mile is about 80 feet. The development contemplated was about 1000-hp and the first unit was started Jan. 1, 1899.

The stream is diverted into a flume, a mile and a half above the power station and ten and a half miles from Lewiston The flume is built of Oregon fir in a very substantial manner, and for most of the way is laid on solid basaltic rock. The canyons en route are trestled over, one of the highest trestles being shown in Fig. 1. This also shows well the volcanic nature of the country. It is hard to believe from a glance at the picture that 200 feet below this trestle a most fertile alley exists. In fact, the fruits raised are the finest in the West.

At the end of the flume a steel 42-inch penstock conducts the water to the power station 120 feet below. The water wheels are twin "American" units, working 100-foot head and 20 feet draft. On the top of the wheel casing is a 6-foot steel column, containing compressed air, and supplied by a small air compressor, shown at the right in Fig. 2. This arrangement proves admirable in relieving any tendency toward water ram, with changes in load on generator. The wheel is governed by a Replogle relay governor. The generators are Walker Company's type, of rotating field and deliver 10,000-volt, three-phase, 60-cycle currents direct to the line. The switchboard was also made by the Walker Company, and is at present of three panels of white marble, as shown in Fig. 4. The generating plant has been in constant service since the first of the year, and has given excellent service.

The transmission lines are of bare copper and undergo three transpositions before reaching the step-down transformer station at Lewiston. En route the transmission line passes through the Snake River Valley, which is covered with fruit ranches. Water for these ranches is to be supplied by pumps direct-connected to alternating current motors. The line also passes through Asotin City, and here a special set of transformers reduce the line pressure from

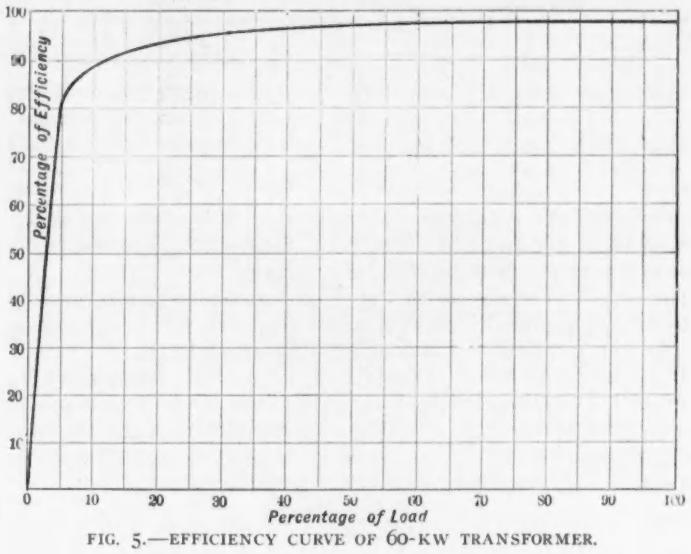
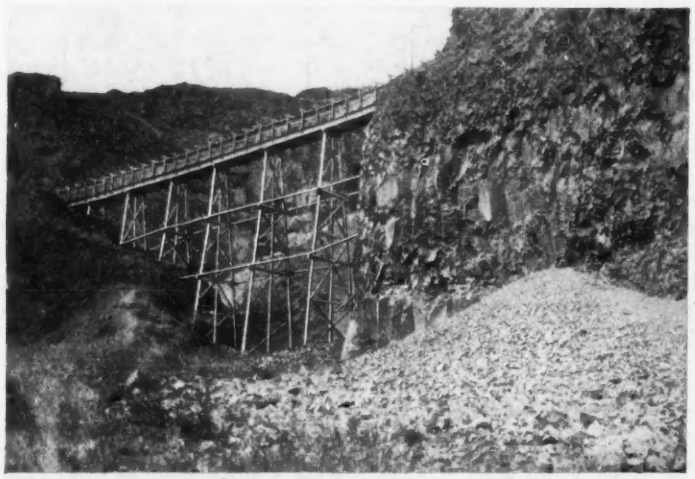
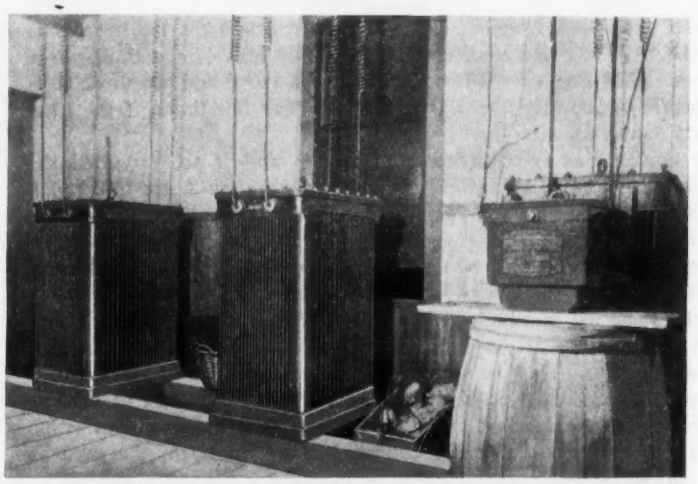


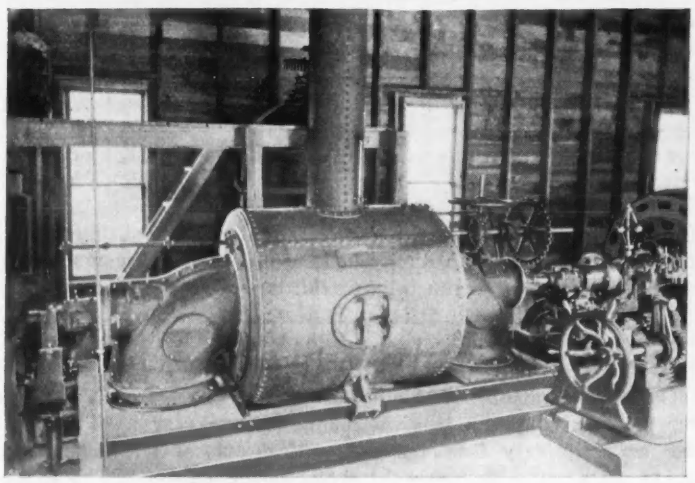
FIG. 5.—EFFICIENCY CURVE OF 60-KW TRANSFORMER.

10,000 to 125 volts, and distribution on 125-volt basis is made, as the service area is centralized.

The substation at Lewiston contains three 60-kw 9000-1000-volt Wagner transformers. This type has corrugated iron cases, as shown in Fig. 3, thus providing a large radiating surface and causing them to be self-cooling. The dimensions over all are 24 ins. x 31 ins. x 47 ins., the weight of entire transformer being 1800 pounds. In Fig. 5







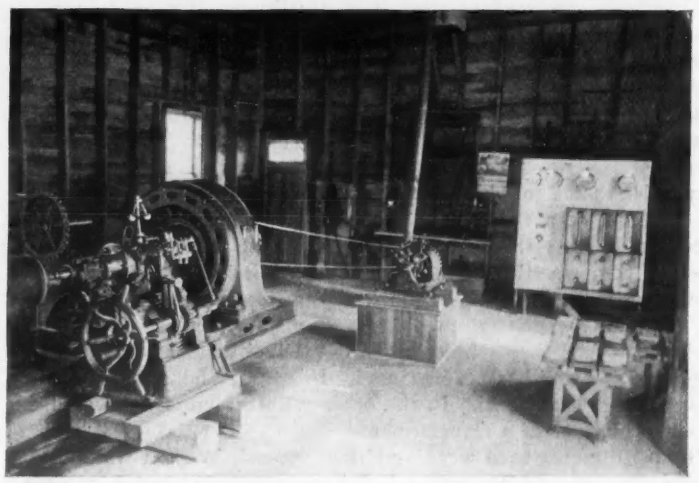


Fig. 1.—Flume Crossing Canyon.
Fig. 2.—Water Wheel.
Fig. 3.—9000-1000-volt Transformers.
Fig. 4.—10,000-volt Generator.

LEWISTON, IDAHO, LONG DISTANCE TRANSMISSION PLANT.

are given the efficiency curves of these transformers, furnished by the makers. The iron loss is 1.28 per cent., the copper loss 1.071

60-KW TRANSFORMER EFFICIENCY CURVE.

Load in kw. Per cent.	Efficiency. Per cent.
5	79.85
10	88.57
25	94.52
50	97.02
75	97.60
100	97.75

per cent., and the regulation 1.071 per cent. The efficiencies at the various loads are given in the accompanying table. The secondary transformers were furnished by the same firm.

The apparatus at the power station and substation is protected by Wurts high potential lightning arresters. The street lighting at Asotin City and Lewiston is done by enclosed arc lamps.

The business of the company has doubled since the new service has been in operation Prof. E. Darrow, of the Washington Agricultural College and School of Science, prepared the hydraulic and electrical plans. Mr. A. W. Kroutinger is secretary and Mr. F. A. Boozer, E. E., is superintendent of the company.

Effect of Inequality of Voltage on Three-Phase Wattmeters in Measuring Motor Loads.

BY AUGUST J. BOWIE.

One form of wattmeter commonly used to measure balanced loads in a three-phase system consists of an ordinary wattmeter with a "Y" box. The "Y" box consists of a non-inductive resistance twice as great as the resistance of the voltage coil of the wattmeter. From the middle point of the "Y" box resistance, a tap is brought out which is connected to one terminal of the voltage coil of the wattmeter. The other terminal of the same coil and the two terminals of the "Y" box are connected to the three legs of the three-phase wires. (See Fig. 1). When the load is balanced and the three voltages are equal, then the wattmeter will read one-third of the total watts delivered.

A motor load is regarded as balanced, and is so, provided the voltages are equal. However, if the three voltages are not equal, then the motor load ceases to be balanced, and the wattmeter will be in error. In that event, the proper method of measuring the power is by the use of two wattmeters, each of which has its current coil in different legs, and its voltage coil from the third leg to the same leg in which the current coil is situated. (See Fig. 2.)

It is commonly asserted that motors tend to equalize the voltages between legs. This is undoubtedly true; but, nevertheless, it is very much at the expense of the motor, the leg common to the two phases with the highest voltages taking more current than either of the other legs. This, of course, has its effect on the drop in the lines.

In properly arranged systems it is usually possible to do away to a great extent with any inequality of voltage between legs. However, there are undoubtedly many places where there will be found as much as 5 per cent. variation in voltage between the legs of a three-phase system, due usually either to induction or to bad balancing. The motors may be totally unable to equalize this voltage.

In order to see to what extent inequality of voltage would affect the readings of a three-phase wattmeter, with a "Y" box, on a motor load, six tests were made. In the first three tests a 5-hp, 190-volt, 60-cycle, three-phase Y-connected induction motor was driving a fan. This made practically a constant load, provided the speed of the generators did not vary. In the last three tests a 5-hp, 60-cycle, three-phase, 110-volt "Delta" connected induction motor driving another fan was used. In tests 1 and 4 the voltages between legs were equal. In the other tests the voltages were distorted by the use of a transformer.

The instruments used were a 7½-kw, 150-volt Weston wattmeter, with a "Y" box, a 25-ampere Thomson ammeter, and a 150-300 volt Weston voltmeter. The instruments were not calibrated. The speed and voltage varied somewhat during the tests These facts will account for some discrepancies in the results.

In the record of the tests the following abbreviations are used:

V, voltage; I, current; W_1, reading of wattmeter with "Y" box; $W = W_1 \times 3$ kilowatts according to "Y" box reading; W_2Ab, reading of wattmeter with current coil in a and voltage coil on a b.

In the first four tests W_2 was taken without the resistance of the "Y" box in series with the voltage coil of the wattmeter.

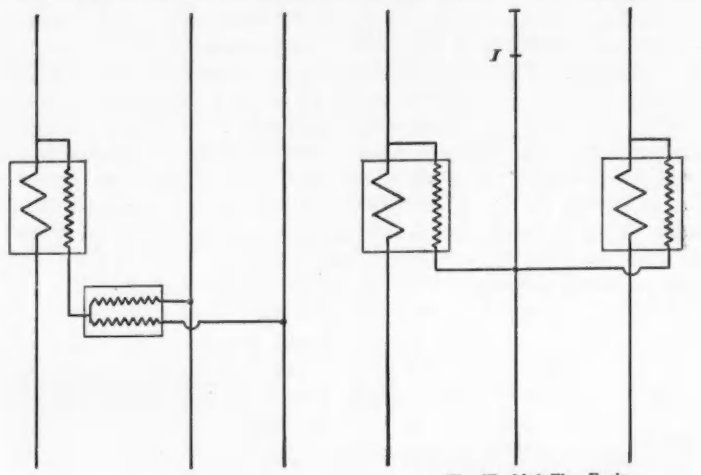
In the last two tests W_2 was taken without the resistance of the "Y" box, in order to give a larger reading W_2, the kilowatts input to motor, was calculated by the two-wattmeter method. This should be the same for any one test, and it should also be equal to cause the average of the three values of W for the same test. The cause of the discrepancies in the results has already been mentioned.

The tests show that under these conditions the three-phase wattmeter with "Y" box is totally unreliable. Thus, for example, the percentage increase of the highest above the lowest of the three readings for any test is as follows:

Voltage	14.5	11	9.3	11.5
Watts (three-phase wattmeter)	141	134	137	148
Current	61	70	44	61

Of course there is no direct connection between the percentage variations of these different quantities.

In some instances the ammeter needle vibrated so violently that



Elec. World & Elec. Eng'r.

FIGS. 1 AND 2.—DIAGRAM OF TESTING ARRANGEMENT.

it was difficult to obtain its correct reading. Aside from the effect of unequal voltages on the wattmeter, is the effect on the motor

SUMMARY OF TESTS.

Test.	V	I	W_1	W	W_2	W_2	W_2
1	ab 254 bc 254 ac 254	A 16.8 B 16.7 C 16.7	A 1.65 B 1.63 C 1.63	A 4.95 B 4.89 C 4.89	Ab 2.12 Bc 2.10 Ca 2.10	Ac .34 Ba .34 Cb .34	Ba, Ca 4.88 Ab, Cb 4.92 Ac, Bc 4.88
2	ab 227 bc 260 ac 243	A 14 B 15.3 C 22.5	A 1 72 B .99 C 2.39	A 5.16 B 2.97 C 7.17	Ab 1.70 Bc 1.63 Ca 2.72	Ac .90 Ba -.19 Cb .85	Ba, Ca 5.06 Ab, Cb 5.10 Ac, Bc 5.06
3	ab 285 bc 257 ac 272	A 20.5 B 18.5 C 12	A 1.65 B 2.32 C .90	A 4.95 B 6.96 C 2.97	Ab 2.52 Bc 2.49 Ca 1.46	Ac .05 Ba 1.02 Cb -.07	Ba, Ca 4.96 Ab, Cb 4.00 Ac, Bc 5.08
4	ab bc } 107.5 ac	B 19	B .71	B 2.13	Bc .97	B1 .14	Ba, Bc 2.22
5	ab 107 bc 117 ac 110	A 16.8 B 19 C 24.2	A .75 B .46 C 1.09	A 2.25 B 1.38 C 3.27	Ab 1.70 Bc 1.78 Ca 2.60	Ac .54 Ba -.13 Cb .56	Ba, Ca 2.47 Ab, Cb 2.32 Ac, Bc 2.32
6	ab 107 bc 96 ac 101.3	A 23.8 B 22 C 13.8	A .76 B 1.09 C .44	A 2.28 B 3.27 C 1.32	Ab 2.21 Bc 2.18 Ca 1.30	Ac .17 Ba 1.05 Cb .13	Ba, Ca 2.35 Ab, Cb 2.34 Ac, Bc 2.35

itself—the result being that some coils are overloaded. Probably, also, this will result in a diminished torque, so that the motor will not be able to carry as much load as if the voltages were equal.

German Telephony in Winter.

Consul Schumann, of Mainz, Germany, in a recent consular report describing the local telephone system, says: "The rates are certainly very low, the charge for a local telephone being $38.55 per annum, including the rental of the instrument. The service, however, is lacking in enterprise. I applied on February 20 to have a telephone placed in my residence, and was told that the connection could not possibly be made before May or June, as they did not string wires in winter."

Applications of Roentgen Rays to Dental Surgery.

BY MARTIN P. RICE.

APPLICATIONS of the new form of radiation discovered by Prof. Röntgen to general surgical cases have been too frequent to merit much attention from the general public. Diseased tissues and fractures of the bones have been diagnosed; bullets, needles, and drills have been located in the flesh, and various foreign bodies in the throats or stomachs of children. In fact, any large hospital where surgical cases are frequent, is not considered well equipped without its set of X-ray apparatus. A Röontgen-ray operator in one of our leading hospitals recently stated that an average of fifteen cases daily were examined or photographed by the invisible ray.

The value of Röntgen rays in dental surgery, however, although early predicted, has until recently been but little realized or developed. Like all Röntgen-ray photography, the process of obtaining a permanent image of the teeth, gums, and jaw depends on the differences in transparency of these parts to the rays.

A general principle, originally stated by Professor Röntgen, is that a crude relation appears to exist between the specific gravities of substances, or their comparative weights of equal volumes, and their transparency to the rays. For example, dense metals like platinum, gold and lead are extremely opaque to Röntgen rays. A piece of gold leaf less than one one-thousandth part of an inch in thickness is more opaque to such rays than a pine board an inch thick. On the other hand, light substances like leather, wood, cloth, or aluminum are extremely transparent, and a very strong application is not required to allow an observer to examine a coin through a volume of 500 pages.

Applying these principles to dental photography, the most opaque substances encountered are gold and other metallic fillings. When they are interposed between the source of the rays and the photographic plate they cast perfectly dark shadows.

Different parts of the tooth structure differ in opacity to the rays, the enamel or outside coating being more opaque while the pulp or nerve and canals of the roots are quite transparent. The bony structure is neither so transparent as the canals and pulp, nor so opaque as the enamel, but differs in different persons.

The gums and jaw bones also have a characteristic degree of transparency, so that a complete radiograph of the jaw and tooth shows not only the outline of the teeth and the connection of their roots with the jaw, but also the canals, relative location of fillings, and an outline of the gums.

The following description of an interesting case gives a fair idea of the most recent methods employed in the application of Röntgen rays to dental surgery. The first or deciduous teeth are generally absorbed before a child is twelve years old, and new teeth supply their places. Occasionally some of the first teeth remain in place much longer and the second set is late in appearing. In such cases the new teeth seldom grow straight, and trouble frequently results before their appearance is detected.

Recently a progressive dentist in New York state had a case in which he suspected a delayed second tooth, but no external examination could either prove or disprove the theory. He finally decided on resource to radiography, and sent the patient to the Schenectady Works of the General Electric Company. A mold of the upper part of the mouth was made in wax and allowed to harden. On it was chiseled a flat surface directly back of the portion of the jaw to be photographed, and just large enough for a photographic film less than an inch square. The film is simply a strip of thin celluloid coated with an emulsion which is sensitive to light. In a dark room the film was cut to such a shape that it would lie evenly on the plane surface chiseled in the wax mold. If was then carefully protected by a double wrapping of black paper so that it would not be acted upon by common light.

The film together with the wax mold was placed in the mouth of the patient and the head held perfectly still for several minutes, while a 160,000-volt current excited the vacuum tube placed in front of the face. Although the photographic film would be absolutely unaffected by ordinary light in its carefully prepared envelope, the Röntgen rays readily penetrate this envelope and cast on the film a shadow of all the parts intervening between the tube and film. On developing the film in a dark room, two small first teeth were clearly shown in the jaw, but their roots were partially absorbed. Behind them and too far up to be shown by an exterior examination, a large second tooth projected obliquely downward. Supplied with photographs from the negatives thus obtained, the dentist now has a clear idea of the condition he has to deal with, and it rests with his skill to adjust the difficulties.

Observations in Radiography.

BY W. C. FUCHS.

Recent observations of radiographs taken by myself have shown the necessity for exercising the utmost care in the selection of back supports for holding plates while the radiograph is being taken. What would serve the purpose best and permit the giving forth of a clear plate is a matter open to suggestion. It is admitted, however, that the support must be a uniform substance, grainless and containing no foreign matter.

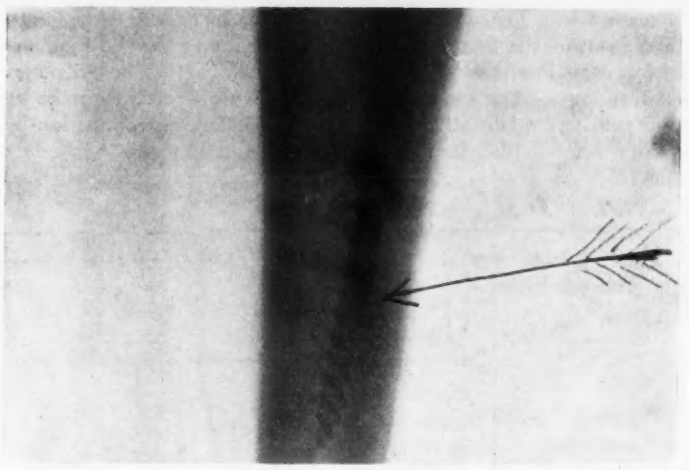


FIG. 1.—RADIOGRAPH SHOWING SCREW BENEATH PHOTOGRAPHIC PLATE.

Experiments made by me have shown in many instances that objects back of the plate appear upon the plate, and this is something that it is necessary to avoid. It also opens up a subject for discussion, for it would be interesting to know definitely the cause of this freak, as it might be termed.

In last July I took a radiograph of the hip joint. The patient was placed on his back over the plate, which was supported by a board perforated with holes about an inch apart and which had been used in the laboratory for experimenting in diversion of rays. In the radiograph, the holes plainly showed. About the same time I took a radiograph of a calf of the leg. The support used was a block of wood in which there was a screw. The radiograph is reproduced in Fig. 1, and the position indicated in Fig. 2.

In the first instance it might be suggested that the result was obtained through deflection of the rays. If this were the case the area of the plate where there are no holes would be more affected than the area with the holes. But it is not, and the reverse is shown. Consequently I can only explain the fact by concentration of rays at points where the holes were bored. The same explanation may be applied to the second case.

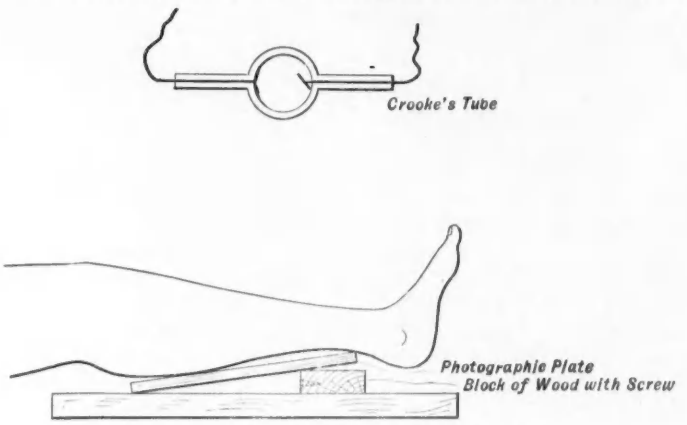


FIG. 2.—ARRANGEMENT IN TAKING RADIOGRAPH.

These are not the only cases of similar nature that I have noticed, but they are the best of quite a number of radiographs taken. Others show the grain of an oak board placed behind the plate.

Improvements in Telephone Systems.—II.

By Kempster B. Miller.

THE second patent referred to in the preceding article was granted to Mr. T. C. Wales, Jr., and is also assigned to the American Bell Telephone Company. The invention of this patent is the result of an attempt to improve existing methods of connecting local lines in a common battery exchange, with long-distance or toll lines. In order to comprehend the improvement, the existing method should be briefly outlined.

If, when an operator answers a call over a local line, she finds that the connection desired is for a long-distance line, she at once informs the special switching operator of the connection wanted, by means of an instruction circuit. This latter operator is seated at a section of the board containing the ordinary multiple jacks—one for each line, and also the plugs in which the long-distance lines terminate. The switching operator then proceeds to make up the circuit, and when all is ready she completes the connection by inserting the plug in which the trunk line terminates, into the regular multiple jack of the subscriber desiring the connection.

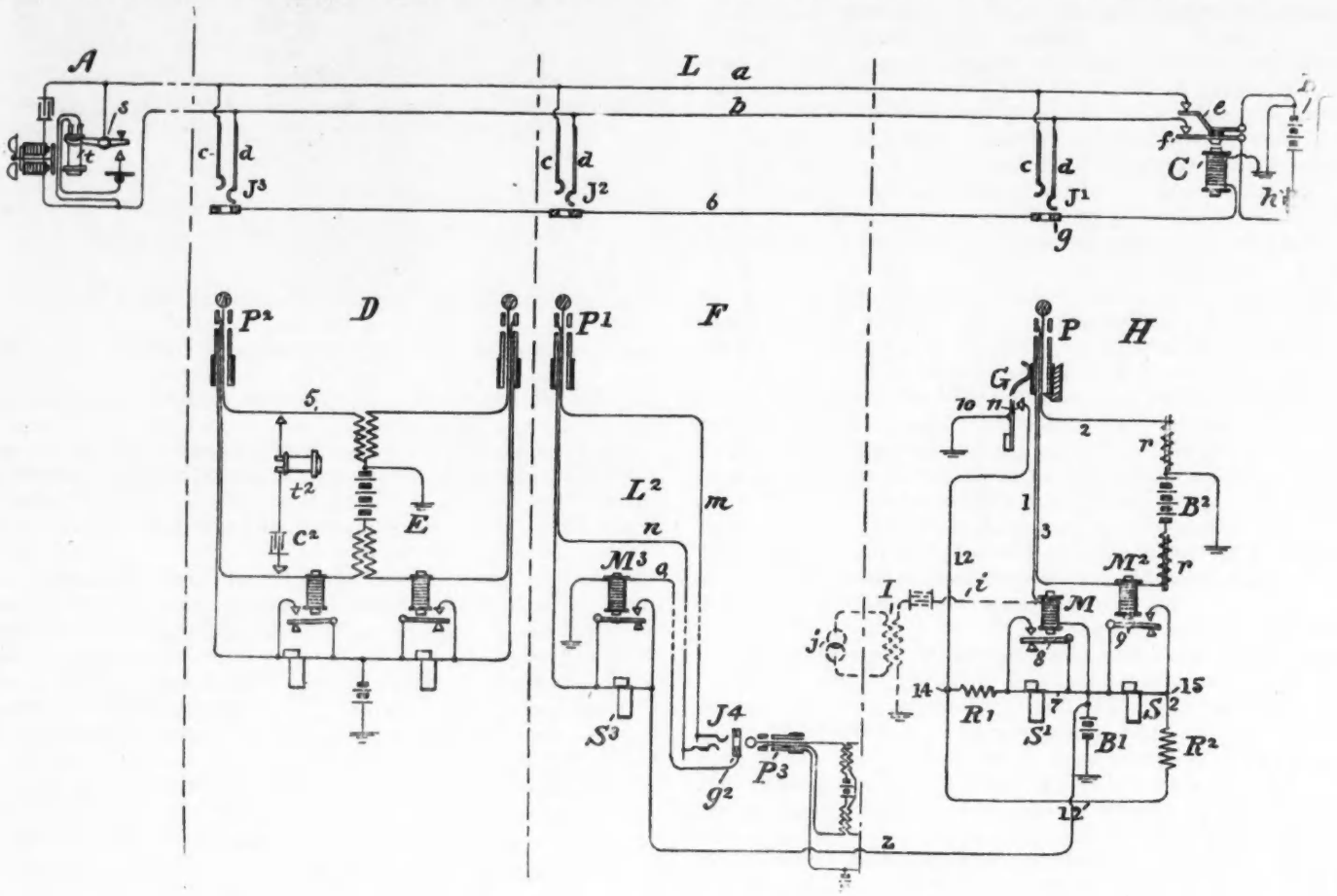


FIG. 2.—WALES SPECIAL PLUG CIRCUIT.

During the interval between the time when the regular answering operator communicates with the switching operator, and the time when the switching operator finally completes the circuit called for, much trouble is often occasioned by the sending of false signals due to the calling subscriber hanging up his receiver, or again removing it from the hook, such action on his part causing the line lamp signal to be lighted or extinguished. Again, the line of the waiting subscriber will not test busy during this interval, and his line is therefore likely to be connected with some other local subscriber at another section of the board.

It is the object of Mr. Wales' invention to do away with these false signals and their annoyances. The circuits employed are shown in Fig. 2, where a single subscriber's line terminates in the substation, *A*, at one end and in the line cut-off relay and other well-known devices at the other end. *H*, *F* and *D* are sections of the multiple board, each having a jack, J^1, J^2, and J^3 connected with the subscriber's line. The section, *F*, is the trunking section provided with plugs, P^1, in which the various trunk lines, such as L^2, terminate. These trunk lines terminate in spring jacks, J^4, at another exchange or at another switchboard. At section *D* is shown a regular pair of plugs and cords with auxiliary apparatus arranged according to the usual common battery system. Each of the sections are provided with these sets of plugs and cords, but for convenience of illustration, they are only represented at section *D*. At section *H* is shown a special plug, *P*, and cord circuit, the arrangement of which, with its auxiliary apparatus, forms the subject of this invention. The connections are quite clearly shown, and need not be described further than to say that *M*, M^2 and M^3 are relays similar to those already described in connection with the supervisory signals of the cord circuits, S^1, S^2 and S^3, are supervisory signals adapted to be shunted by their respective relays, and R^1 and R^2 are resistances adapted to modify the flow of current through the circuits in which they are placed. *I* is an induction coil used to associate the small alternating current generator, *j*, through a condenser and wire, *i*, with the strand, 1, connected with the test sleeve of the plug, *P*. This latter apparatus is for the production of the tone test, which is now being used in some cases in place of the ordinary click test for the determination of busy lines.

Assuming that subscriber *A* desires a connection with a long-distance line, the removal of his receiver from its hook will operate the relay, *h*, and illuminate the lamp signal, *S*, in a manner well understood. This call will be answered by the operator at section *H* with one of the regular pairs of plugs, such as is shown at section *D*. Learning, however, that the connection desired will require the use of a trunk line, she replaces the regular plug with the special plug, *P*, or, more properly, she places the plug *P* in the regular connecting multiple jack, and then removes the regular plug from the answering jack. The switching operator at section *F* having been notified of the connection desired, proceeds to make up the circuit, and while she is doing this, the apparatus of the special plug *P* performs its work.

Upon the insertion of the plug *P* into the jack of the subscriber's line, current from the battery B^1 flows through the relay *M* to the test thimble *G* and test wire 6, through relay *C*, to ground. This performs three functions:

First: it maintains the test thimbles of all the jacks on that line at a potential different from that of the earth, or, when a tone test is used, it maintains an alternating e. m. f., due the generator, *j*, upon all of the test thimbles, so that an operator at another board

will hear a click or a hum in her telephone when testing, according to which system is used; Second: the current from the battery B^1 operates the line cut-off relay C, thus cutting off all of the apparatus beyond the jacks at the points e and f; Third: the relay M is operated, thus short circuiting the signal S^1.

Current from the battery, B^2, circulates through the subscriber's line, provided his receiver is removed from its hook, thus actuating the relay M^2 and shunting the signal S^2. When the plug P was removed from its seat, the spring G of a plug seat switch, moved against the anvil, 11, and grounded the line, 12. This allowed current from the battery B^1 to flow through the relay armatures, 8 and 9, in multiple and through the resistances R^1 and R^2 in multiple, through the wire 12 and to ground through the plug seat switch.

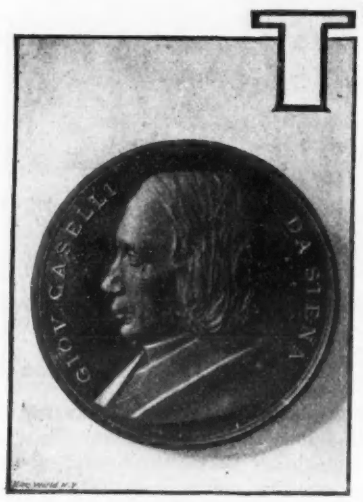
If at any time the subscriber hangs up his receiver the line circuit will be opened at the condenser at his station, and the relay, M^2, will therefore release its armature, and thus display the signal, S^2. The subscriber may thus at any time signal the answering operator by alternately raising and lowering his switch lever, thus operating the signal, S^2. The signal, S^1, remains inert until the switching operator completes the connection by inserting the plug, P^1, into the jack of the subscriber's line. The relay, M^3, remains inert until the operator at the distant station inserts the plug, P^2, into the jack, J^4, of the trunk line, L^2. This act allows current from the grounded cord circuit battery to flow through the relay, M^3, thus actuating it and short circuiting the signal, S^3, and showing the switching operator that all is ready. She then inserts the plug, P^1, in the jack of the waiting subscriber's line, thus completing the connection. This act, moreover, creates a short circuit about the relay, M, which short circuit may be traced through wire, z, armature of relay, M^3, test thimble, G, and wire 6 of the subscriber's line to the relay C. This circuit contains no coils whatever, and, therefore, takes practically all of the current from the relay, M, causing it to relase its armature, 8, thus energizing signal, S^1. This signal informs the answering operator at section H that she may withdraw the special plug, P, which she does.

The operation of this system may be made somewhat clearer by remembering that the signal, S^2, is controlled entirely by the calling subscriber, the signal, S^3, by the operator at the distant end of the trunk line, L^2, and the signal, S^1, by the switching operator at section F.

The tone test described is coming into use to a considerable extent in some of the more modern exchanges. It would be an interesting matter to trace the development of this form of test, the general idea of which is by no means new.

Electricity in the Italian Navy—VI.

By GIULIO MARTINEZ.



THERE was on exhibition at Turin, a piece of apparatus invented by the author which is the first step in the solution of the problem of electrical steering gear. That it has merits is proven by the satisfactory results obtained with some specimens in actual use, and by its ability to hold the attention of the jury of the exposition. The present form of this apparatus is the result of some suggestions made by Mr. Pasqualini and also of an examination of a forgotten invention made some fifteen years ago by the Abbe Caselli (see initial cut), well-known as the inventor of the Pantelegraph. The present apparatus differs radically from Caselli's, whose machine is chiefly of value from the historical point of view, and as a proof of the power of the inventor's genius.

A motor of 40 to 50-hp, which would be required to move the rudder of a vessel, is in excess of the capacities of the electrical installations found on modern ships, and the mechanical arrangements in use for controlling the different valves of the steam apparatus which moves the rudder are complicated and expensive. Hence the problem is reduced to devising some means for electrically controlling the steam steering gear from the bridge or some other part of the vessel.

All systems which rely on transmitting a signal to move the rudder, repeating back the signal after the execution of the order, are far from satisfactory. The desideratum is to have under the control of the helmsman a wheel and an indicator showing the position of the rudder at all times. The motion of the wheel must be transmitted to a shaft controlling the valve of the steam gear, and the motion of the shaft must be proportional to that of the wheel, and must be recorded by the indicator.

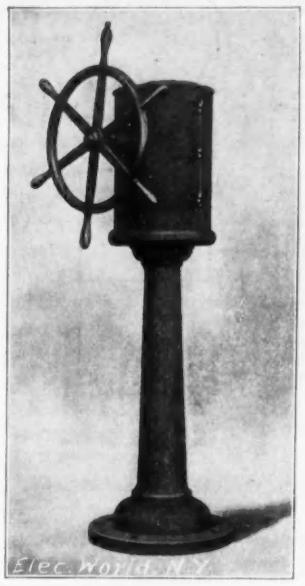


FIG. 39.—ELECTRIC STEERING GEAR—TRANSMITTER.

The apparatus comprises a transmitter, Fig. 39, and a receiver, Fig. 40. The toothed wheel shown in the cut of the receiver reproduces exactly the motion of the steering wheel, and is driven by an electric motor of sufficient power to work the valve.

The motion is transmitted to the valve wheel by an endless chain which can be easily removed in case of accident. The motor of the receiver is usually a 4-pole type, and one which answers the purpose very satisfactorily is the Storey motor, Fig. 40, of American manufacture.

The action of the apparatus is extremely simple; in the first place, the motor is connected with a Pasqualini controller of the type used with searchlights, as previously described; the resistance in shunt across the terminals of the armatures are two lamps, one colored red and the other green.

Normally the lamps are lighted and they can be put in sight of the steersman, thus indicating that the apparatus is in working order, as far as the current is concerned. Again, since one lamp is extinguished when there is motion of the regulator in one direction and vice versa, the lamps also indicate that the controller is operating.

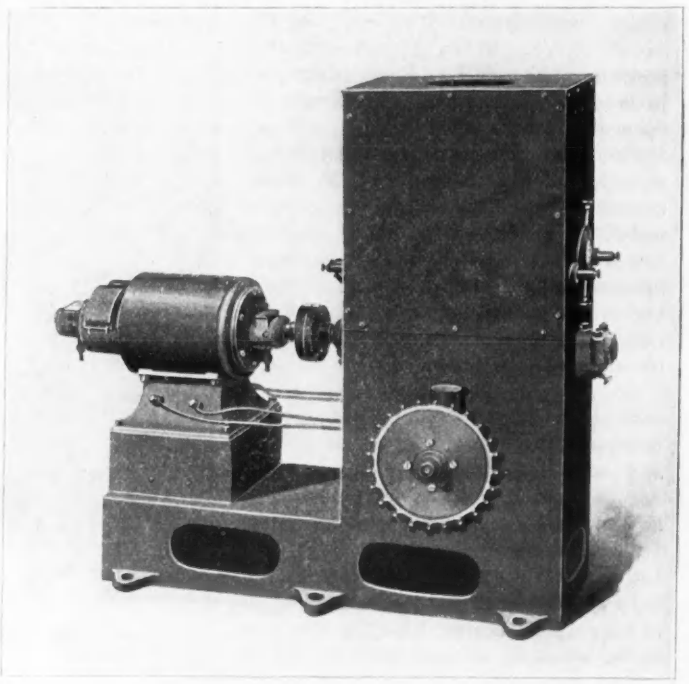


FIG. 40.—ELECTRIC STEERING GEAR—RECEIVER.

The transmitter closes the circuits of the electro magnets, holding them in until the motor has produced a movement of the valve proportional to the motion of the steering wheel. The method of obtaining this result is detailed to the left in Fig. 41.

Two spiral springs T^1 and T^2, coiled in opposite directions, connect a horizontal gear wheel, R to its shaft A; this wheel R is in

connection through a bevel gear with the steering wheel on the outside of the box. Any movement of the steering wheel causes R to revolve and the shaft *A* would follow the motion as the result of the effect of the springs, but for an escapement Z. Only one tooth of the escapement can pass the catch each time that the lever H is displaced by a pull from the magnet E^1.

Evidently in order that the shaft *A* may take up the same "zero" position which it had with regard to the wheel R, the magnet E^1

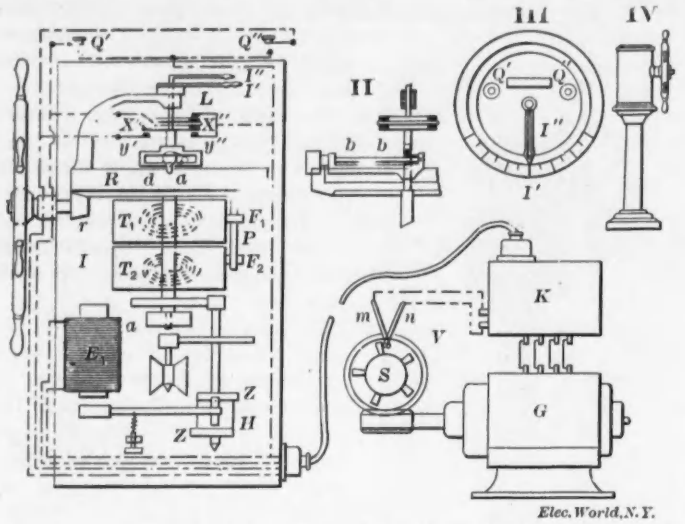


FIG. 41.—DIAGRAM OF MARTINEZ ELECTRIC STEERING GEAR APPARATUS.

must have attracted its armature a number of times directly proportional to the amount of rotation communicated to R by the steering wheel. It is not difficult to conceive a mechanical arrangement whereby each time the wheel R changes its position relatively to the shaft *a* either right-handedly or left-handedly, one of two circuits will be closed. These circuits are the circuits of the two magnets of the controller, and the arrangement is completed by a vertical rod which rises or falls when a cam is displaced from a recess in the wheel R.

Detail II. shows the construction of this rod and cam, the displacing of which closes either the circuit X^1, X^{11}, or the circuit Y^1, Y^{11}. When *A* reaches its zero position with regard to R, the cam goes back into place and the circuit is opened.

The motor of the receiver drives, by suitable gears, both the wheel V, which reproduces the motion of the steering wheel, and the rotary interrupter S, which causes interruptions in a circuit between *M* and *N* proportional in number to the number of turns made by the motor *C*. This circuit includes the electromagnet of the transmitter.

To sum up the action, suppose the steering wheel to be moved through a definite angle, the motor starts at once and stops only when it has made a number of revolutions proportional to the amount of motion of the steering wheel, because only at that moment can it have transmitted a sufficient number of impulses over the circuit to cause the shaft to take up its normal position relatively to the wheel R.

Two pointers I^1 and I^{11} connect with the wheel R and the shaft *a* and indicate on a dial (III.) the amount of angular motion imparted to the steering wheel and show likewise the instantaneous position of the valve lever. The rotary interrupter S can just as well be started directly from the lever, in which case the pointer I^{11} will always indicate the true position of the lever.

The receiver and transmitter are connected by a flexible cable of four conductors. This mechanism is in use on the cruiser Calabria, and the battleship Ruggero di Lauria, and will be used on the E. Filiberto.

This subject is regarded as being very important in the Italian Navy, and other apparatus has been tried, the most notable specimens being that on the Re Umberto, gotten up by Commander Moreno, and another designed by Guzzi and Ravizza of Milan. But none of these was able to maintain proportionality between the motion of the transmitter and the receiver, notwithstanding that Caselli's invention had pointed out the solution of the problem, years ago.

In the last years of his life this great and unfortunate inventor was absorbed in the solution of three naval problems, the dirigible torpedo, a rudder to be automatically steered by the compass, and a mechanism for electrically controlling the steam steering gear from the steering wheel.

This work was going on between 1881 and 1885, when electricity was still a new thing and Caselli had to procure a special generator to generate a current supply with; he had been intending to use a Gramme-Brotherhood outfit.

The Abbe Caselli died before he could finish his invention, but enough of it remains to show that he had the right idea. He also made use of a transmitter and a receiver but the latter depended on a small steam engine started by a relay. The relay was undoubtedly built, but I was unable to find it.

The transmitter is shown in Figs. 42 and 43. A steering wheel was mounted on the shaft seen at the side; and any motion of this wheel immediately closed a circuit, at the same time displacing a carriage along a screw in the centre of the apparatus. There were two electro magnets, the one or the other (according to the direction of motion of the carriage) acting on the carriage and returning it to its original position, where the circuit would again be broken. The impulses sent to these electromagnets were controlled from the small steam engine, a cut of which is shown for the sake of the historical interest. (See Fig. 44.)

There is yet another extremely important use to which the electromotor is to be put; that is, in the opening and closing of doors in water-tight compartments. The apparatus is being designed by the Technomasio of Milan, and is intended for the St. Bon, but no details have been given out as yet.

I must speak once more of the Marconi system of telegraphy, which has been the object of much careful research.

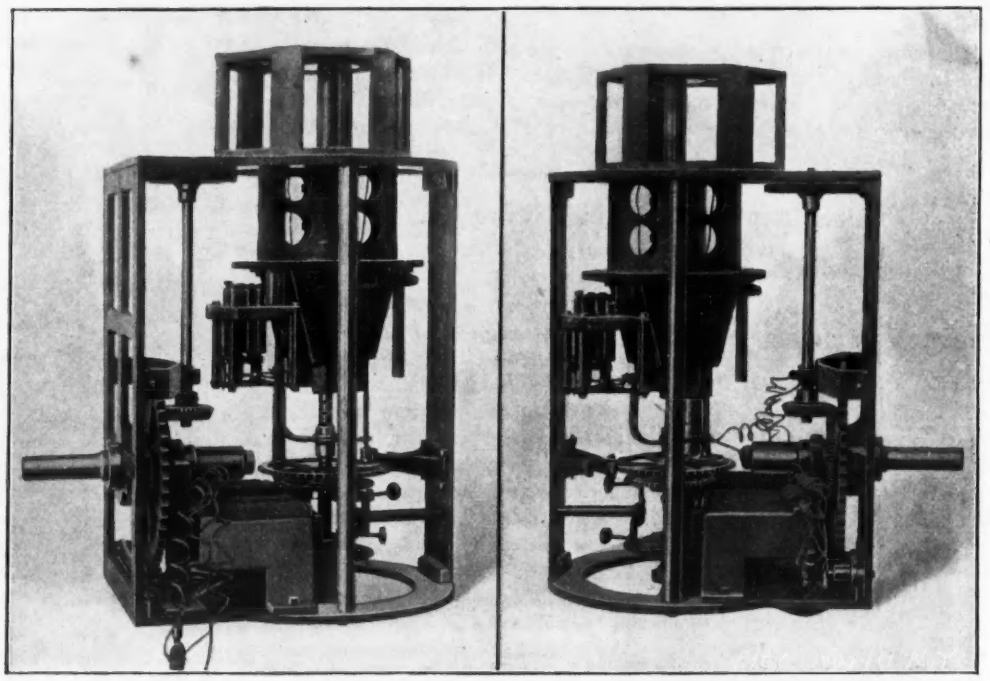


FIG. 42.—CASELLI STEERING GEAR—TRANSMITTER.

FIG. 43.—CASELLI STEERING GEAR—RECEIVER.

So far the result reached is the ability to transmit over a distance of 24 miles with absolute certainty. This is entirely the effect of M. Pasqualini's improvements.

Marconi's apparatus was exhibited in the gallery at the Turin exposition; it was operated from time to time over a short distance and attracted much attention. The arrangement of apparatus was the old one well known to electricians, consisting of a Righi oscillator, a coherer, a relay and a Morse registering machine.

But after lengthy experiments, the chief electrician of the navy became convinced that resonance and electrical oscillations were not the causes of the phenomenon. This idea suggested itself to M.

Pasqualini at the outset, during the first experiments which he attended. His idea met with much opposition, but his new apparatus leaves no room for doubt as to its correctness.

The transmitter is an induction coil, the primary circuit containing a regular rotary interrupter and a Morse key; the secondary circuit contains no oscillator, but simply two globes with a space between them from one to two inches wide.

The discharge occurs in the air, and this air gap just mentioned seems to give the best results. (Naturally this arrangement does not prevent the discharge from being oscillatory in character, but we shall see that the explanation of the phenomenon does not require it to be so.)

The receiver consists of a coherer, which is shaken up by a continuous tapping from a small hammer actuated by a train of gears; a dry cell and a Weston voltmeter, complete the outfit.

There is nothing which needs to be adjusted, and the reading is easily done from the short and long deflections, corresponding to the dots and dashes of the Morse alphabet. Messages could be taken down by a siphon recorder.

The transmitter is connected to a vertical rod made as high as

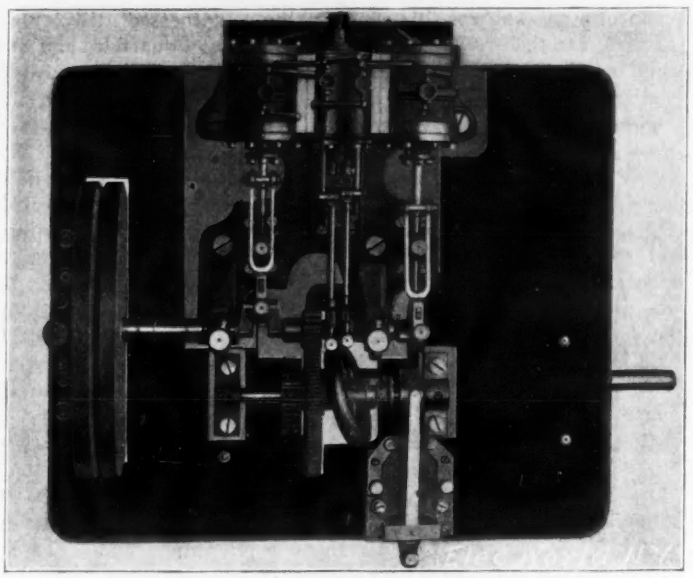


FIG. 44.—STEAM ENGINES FOR CONTROLLING IMPULSES.

possible, and a kite with a copper cord connection is usually employed with the receiver. In the 24-mile experiments the rod used with the transmitter was 100 feet high, and the receiver, placed on board a torpedo boat, was connected with the copper cord of a Hargrave kite, which flew at a height of 230 feet with about 500 feet of cable unreeled.

According to M. Pasqualini, the action is the result entirely of the single discharge or the first half wave of an oscillatory discharge, the subsequent waves being without any effect in increasing the intense electro-magnetic field then generated. The field set up by the discharge must be extremely strong, because of the rapidity of the variation of the current, and the secondary wire becomes the seat of an e. m. f. of sufficient magnitude to operate the coherer; the subsequent e. m. fs. induced by an oscillatory discharge produces no effect.

Instead of attempting to produce oscillatory discharges there should be produced discharges which die rapidly that the e. m. fs. induced by an oscillatory discharge produce no effect. Instead of attempting to produce oscillatory discharges, the attempt should be to produce discharges which die down rapidly in order that the first wave may have the greatest possible intensity. The proof that the oscillatory discharge is unnecessary lies in the fact that an instantaneous e. m. f. of sufficiently high value set up in the coherer circuit, makes the coherer a conductor; and this effect may be obtained with the aid of an electric bell, which certainly is not oscillatory.

The Marconi telegraphy is then simply a phenomenon of electro-magnetic induction, which can be felt at great distances, on account of its own intensity, and the sensitiveness of the coherer.

The only argument which was brought up in support of the oscillatory theory, lay in the idea that it was necessary to have tuned apparatus, an indication of resonance effects. This has been proven not to be the case.

It is to be hoped that M. Pasqualini will publish the results of his experiments, which I have been enabled to sketch out for the readers of this journal, thanks only to his kindness in explaining them to me.

To the reader also my thanks are due, who has had the patience to follow my article through to the end.

Municipal Ownership in Massachusetts.

By M. J. Francisco.

The recent report of the Gas and Electric Light Commissioners of Massachusetts, discloses some very important facts regarding municipal ownership, and proves conclusively that the system is a failure in that state.

On the 79th page of this report the expenses of all the municipal plants in the state are given as $150,536.20, and the entire income or receipts of the same plants from every source was $88,181.59, thus leaving a balance of expenses over income of $62,354.61. On the 78th page the Commissioners state that the investment made to establish these plants was $1,164,267; 4% interest upon this amount is $46,570.68 and 5% depreciation on the same is $58,213.35. The average rate of taxes in towns where these plants are located is $17.38 per $1000 as shown on page 78. At this rate, calling their taxable value at $823,279.58, as shown on page 81 (which is $340,987 less than their investment), the taxes would be $14,308.59, making a total of $181,447.23, as the annual cost of 1208 arc lamps, or $150.20 per lamp.

On page 88 we find the number of arc and incandescent lamps furnished by these plants and the hours run. If we convert the incandescent lamps into their equivalent in arc lamps, we have 1208 arc lights of 1200-cp, burned only 6.8 hours per night and 23.14 nights per month. The same report shows the business of private companies, and we find that taking the same number of private plants furnishing street lights in Massachusetts by contract, the average price for a 1200-cp lamp, was $81.31 per year, burning 7.9 hours per night 27.7 nights per month. This gives over one hour per night longer service, and four nights more per month, and at a cost of a little over half what it cost the municipal plants to produce the same lights. In addition, the private companies paid $31,516.11 in taxes to the municipalities.

The figures in both cases are the official statements as made to and verified by the State Commissioners. The actual record of every municipal plant in Massachusetts is given, and taxpayers in other states who are confronted with municipal ownership might well investigate these official figures.

Another fact disclosed by this report is the increase of taxation entailed by municipal ownership. When its plant was established, the rate of taxation in Braintree was $17.60 per $1000, and it is now $18.20. In Danvers it was $17.00 and now is $19.20. Similarly the increase in Marblehead was from $17.90 to $19.20; in Middleborough, from $16.66 to $22.10; and in Reading, from $15.50 to $18.00—thus indicating a steady increase arising from municipal ownership.

As shown on page 78, the investment made for municipal plants was $1,164,267.00, while on page 81 is given the balance sheets, showing the total assets of all the municipal plants in the state to be only $823,279.58. If the taxpayers invested $1,164,267.00, as the Commissioners say they did, and now have property amounting to only $823,279.58 to show for this investment, where is the balance between the two items amounting to $340,987.00? Is this not a direct loss to the taxpayers of Massachusetts, caused by municipal ownership?

The expenses of these plants increase year by year, as shown by the records. The Braintree station in 1897 burned 753 tons of coal, while in 1898 973 tons were burned and only three more lamps were in circuit during the latter year than had previously been used, though 220 tons more coal was consumed. Danvers added only fifteen lamps during the year, while its station used 253 tons more of coal than it did the previous year and used the lights a less number of hours.

Wages, repairs on lines and lamps, salaries, office and law expenses, cost of globes and bad debts, all increased in 1898 over 1897, and in some cases the items are doubled.

A great deal is said about the outrage of private companies

charging $1.25 per thousand for gas. There are two municipal gas plants in Massachusetts, at Middleborough and Wakefield. The first named charges $2.64 per thousand and the latter $1.76 per thousand for gas, while a private company in Haverhill furnishes it for $1.30 and one in Lawrence at $1.50 per thousand.

The statement of advocates of municipal ownership that gas and electric lights can be furnished by the municipalities cheaper than is charged by private companies, is thus disproved by the actual experience of all the municipal plants in Massachusetts. It is claimed that New York can produce gas for 50 cents per thousand. Why, then, could not Philadelphia do so, and why does it cost the municipal plants in Massachusetts from $1.76 to $2.64 per thousand, as the report quoted from shows that it does.

If every state had a Gas and Electric Light Commission similar to that of Massachusetts, the real cost of electric lighting by municipalities would be shown, and the public could no longer be deceived by the wild statements made by the advocates of municipal ownership.

An Interesting Electrical Dinner in Philadelphia.

Last week, on April 12, at the well-known Art Club in Philadelphia, an inner, esoteric circle of that institution, known as the Nameless Dining Club, held its regular meeting, taking, as is its wont, some special topic for treatment and discussion, and on this occasion selecting Electricity as the theme. A party of between 40 and 50 gathered in a private dining room, including many leading and representative Philadelphians and having as its electrical

A. E. NEWTON.

H. B. CUTTER.

contingent the following, many of whom were present as the guests of the evening through the courtesy of Mr. A. E. Newton and Mr. H. B. Cutter, of the Cutter Electrical Manufacturing Company of Philadelphia; J. H. Vail, chief engineer, Pennsylvania Light, Heat & Power Company; Charles Hewitt, electrical engineer, Union Traction Company, of Philadelphia; L. G. Paul, Electro Dynamic Company; C. A. Bragg, Westinghouse Electric and Manufacturing Company; W. H. Tapley, electrician Government Printing office, Washington; W. M. Scott, electrical enginerr, Cutter Company; J. G. Biddle, C. J. Dougherty, chief electrician, Cramp's; E. S. Keefer, Western Electric Company; Dr. Carl Hering, J. M. Wakeman and T. C. Martin, of the ELECTRICAL WORLD AND ELECTRICAL ENGINEER; Gano S. Dunn and S. Russell, of the Crocker-Wheeler Electric Co.; Dr. A. W. Goodspeed, R. P. Bolton, consulting engineer; J. P. Croasdale, patent attorney. Among the others present may be mentioned Harrison Morris, editor of Lippincott's *Magazine*; Captain Paul Makedonsky, of the Russian Navy; James Beck, United States District Attorney; John Boyle, the sculptor, whose statue of Franklin is to be unveiled next June, and Dr. A. G. Lambden, editor of the Philadelphia *Times*, who officiated most felicitously as toastmaster and interlocutor. One of the curious features of the evening was that all the speeches were made with the speakers sitting, so that their remarks should not be over the heads of their auditors.

The ball was set rolling by Dr. Hering, who dated all electrical development from Franklin and Philadelphia about 150 years ago, and who quoted some remarkable passages from the writings of the philosopher to show his insight into the far future of the arts then so young. Dr. Hering traced the gradual development of electricity in its scientific and industrial sequence, and closed with some suggestive comments on the possibilities of transmutation of the metals due to the command of new processes given us by the universal agent electricity, on lines pointed out by Lord Kelvin, Prof. J. J. Thomson and others.

Mr. Gano S. Dunn, chief engineer of the Crocker-Wheeler Electric Company, being invited by Dr. Lambden to discuss the industrial applications of electricity said: To illustrate the influence of electric power upon industrial methods, I would cite an achievement of Philadelphia of which the whole country is proud. It was necessary to follow up Sir Herbert Kitchener's victorious march into the Soudan with a railroad to forward supplies and to develop in other ways that vast region. This railroad was wanted most urgently—it was an absolute necessity. The Atbara River, which is an important tributary to the Nile blocked its passage and the British government officials in Egypt asked for bids all over the world for the promptest construction of a bridge of seven spans to carry the railroad across this great natural obstacle. Time was of vital importance, and cost a secondary matter. The earliest delivery that could be obtained from any of the English firms, was for two of the spans in six months A. &. P. Roberts Company, of Philadelphia, owning the Pencoyd Iron Works, guaranteed to deliver the whole bridge in seven weeks.

So unparalleled was this remarkable promptness of delivery, that suspicions were aroused that the bid was not bona fide, and some time was lost by the Egyptian officials in determining the responsibility of the Philadelphia firm. The order was cabled to them under condition that they would deliver two of the spans in the time they had named for the whole, but to this they replied: "It is easier to do the whole thing at once." Notwithstanding the February blizzard, which deprived the Pencoyd Works of coal, causing the shutting down of a number of their furnaces and the chilling of the steel which was to be rolled for the the bridge, the complete structure was turned out in thirty-two working days, and less than six calendar weeks. This wonderful accomplishment has brought down upon the American builders, charges of underhand practice and insinuations of fraud, but it is needless to say these are groundless, and that this will be seen by their competitors when they come to study the subject.

The reason why the American constructors have led the world in this instance, crowding British firms out of a territory which they had considered exclusively their own, lies in the fact that the Americans have been quick to adopt every improvement in methods, of which electric power is probably the most important. The Pencoyd Works is operated wholly by electricity, and remarkable economies result. The saving in power over that which would be required to operate the cranes and other machinery of the works by scattered steam engines, is a large and important item; but it is insignificant compared to the indirect gains in convenience and flexibility which the electric system permits. For instance, by the introduction into the bridge department of the electrical methods of handling, a girder which formerly required nearly half a day to be turned over, to permit work upon its other side, is now turned in half an hour.

The direct attachment of motors to the large tools, has permitted the removal of overhead gear and belting, and given such added clear space that the problems of handling are no longer difficult. It has also greatly simplified the manipulation and adjustments that were extremely awkward when power had to be carried to semi-portable tools by means of belts. Portable tools are now carried to work which previously had to be brought to the tools. The net result of the introduction of these and other improvements due to electrical methods, is that the tonnage of output for the same number of hands, tools, etc., has actually been doubled, or, the time required for a given output, halved, with the corresponding effect on the cost of labor.

Mr. Charles Hewitt, electrical engineer of the Union Traction Company, of Philadelphia, pointed out several features of advantage in the operation of street railways by electricity, and among these included the fact that the company had smoothly repaved some 400 miles of the streets of the city, a burden of expense that he hardly considered proper to fall upon an enterprise doing so much good for the community. He also described the work done by a storage battery situated nine miles from the power-house in facilitating the work of the system and in heightening economy of operation at the same time. This elicited quite a discussion participated in by Mr. Cutter and several others.

Mr. T. C. Martin being left by the toastmaster to select his own point of view, suggested that for once, after so much optimism, it

might be well to point out the possibly pessimistic sides of electricity, which was not in its infancy of 150 years, but an aged disturber 2000 years old at least, like the little fairy ballet girl who when offered a glass of milk and a bit of sponge cake, said she had just sent out for her usual glass of port and sandwich. He would like to characterize electricity in one word as "brevity," which described its every phenomenon except the speeches made about it. But for the telegraph and cable, Dewey might not be at Manila, and the Philippines were not yet on the list of things for Thanksgiving. In New York City, there were 300,000 telephone messages a day, which, allowing 10 per boy, showed that about 30,000 district messengers would be needed to carry them. Thus the telephone obviously acted as a Malthusian check on population. There were possible the same drawbacks with electric traction, and now the automobiles by banishing horses from the streets were depriving the sparrows of their hot breakfasts. In fact, the older arts and craftsmen were often inclined to feel towards electricians in the same way as the 25-cent magazinists did towards the 10 centers, but they would have to live that down. He would not, however, ask them to believe that electricity was the greatest blessing of the age, because a distinguished English authority had claimed that ascription for "sixpenny photographs" for the people; and, of course, it was idle to compare the incandescent lamp to the lucifer match.

Mr. C. J. Dougherty, chief electrician at Cramp's, made a most interesting statement as to the use of electricity on board modern men of war, speaking primarily of the good results obtained in the war with Spain. He then went on to show how electricity is approved of in the Russian navy, and described the similar plants to be installed by Cramp's on the battleship and the cruiser they are now building for the Czar.

These plants will be the largest that have ever been installed on any warship in this country. On the battleship, motors will be installed for the following work; capstan, drainage turbines, hull ventilation, blowers for firerooms, winches for boats, shop motor, ash hoist motors, ammunition hoist motors, and the operation of the turrets and steering gear by electricity. There will be installed on this ship alone about eighty-nine motors and the generating units for supplying power for these motors, for 1000 electric lights and for six searchlights will be: 4 66-kw generating sets, each set consisting of a triple expansion engine directly connected to 2 33-kw dynamos, two generating sets of 132-kw, each set consisting of a triple expansion engine directly connected to two dynamos of 66-kw. The total amount of current which can be supplied by the above dynamos is roughly, 5800 amperes. This is a large installation of electric power and it will be noticed that the Russian navy has plenty of faith in electrically operated machinery.

Mr. W. H. Tapley, electrician, of the Government Printing office, at Washington, gave some most interesting data as to the part played by electricity in that vast establishment, the largest in the world so operated. At Mr. Cutter's suggestion he dwelt upon the wonderful cleanliness and airiness resulting from the dismissal of belts, shafts, etc., and the operation of the presses, etc., by motors directly attached. Mr. Tapley also described the marvelous speed made in receiving at night, on one occasion, the manuscript of the "Maine" report, and on another occasion the report of the Committee on Foreign Relations, and having some 2500 copies of each ready in morning for the use of the President and of Congress. In this connection he noted the fact that all the half-tone cuts, etc., in the "Maine" report were made during the one night by the aid of the electric arc light, and thus appeared in the book, although such celerity has been described as impossible by engravers.

Dr. A. W. Goodspeed, the well-known radiographer, had with him a fine new bulb of latest type, and with its aid he described the various phenomena of the Roentgen ray, giving a most admirable description of its nature, possibilities, results, etc. Later in the evening, with the expert aid of Mr. Biddle, he gave a demonstration with the tube, which proved very attractive and instructive.

Mr. Reginald Pelham Bolton, the electrical engineer of New York, brought the general speeches to a close with some references to the branch of traction that had not been referred to, namely the vertical, or that effected by elevators. He said that in New York alone, for instance, the vertical travel by elevators in the southern end of the island, below Canal Street, might be estimated at 500 miles every day of ten hours. Of this, the electrical travel would be about 150 miles in the ten hours. The elevator travel might easily run up to 1,000,000 people a day for the city. There were 60 downtown skyscrapers alone, and each of these had a travel of from 5000 to 15,000 passengers daily, i. e., 2500 to 7500 up and down. This feature of travel was often overlooked in estimating the movement of population.

Mr. Gano S. Dunn, by request as an old telegrapher, gave an excellent popular account of the principles of wireless telegraphy.

A little badinage ensued at this stage, between Messrs. Cutter and Newton, from which it appeared that the later, who is a member of the Grolier Club, is presenting to the Nameless Club the fine Grolier etching of Franklin, as a souvenir of the pleasant and memorable social-scientific evening in which they had thus participated. Mr. G. S. Dunn, in closing expressed the thanks of the guests towards their generous hosts.

CURRENT NEWS AND NOTES.

BRIG. GEN. EUGENE GRIFFIN has approved a scheme to attach a corps of engineers to the Second Brigade of the National Guard for the State of New York, with headquarters in Brooklyn.

HOMES FOR GENERAL ELECTRIC COMPANY'S OFFICIALS.—The General Electric Company recently purchased 76 acres of land from Union College, at Schenectady, N. Y., paying, it is reported, $750 per acre. This tract, which is over a mile distant from the company's works, is to be used as the site for the residences of officers and principal employees of the company.

VAUDEVILLE SHOWS ON TROLLEY CARS.—Continuous vaudeville performances on trolley cars is a promised novelty for the insatiable craving for novelties of New Yorkers. The cars will be run from the Brooklyn Bridge to Bensonhurst and Coney Island, and the service, it is reported, will commence on May 17. The promoters of the enterprise, Messrs. Hurtig & Seamon, proprietors of the Harlem Music Hall, have contracted with the John Stevenson Company to build two cars especially for this service. The cars will be extra long and will have accommodation for an audience of sixty passengers. A small platform for the performers will be provided at one end. The cars will be equipped with upholstered theatre chairs and will be decorated in white and gold. Hourly trips will be made from each end of the line, each trip taking a little less than an hour. A fare of 25 cents per trip will be charged.

COPPER STATISTICS showing United States production, exports and European production for the first quarter of the current calendar year present some record-breaking figures. Perhaps the most remarkable feature is the foreign demand for copper as reflected in the large volume of our exports, those for March amounting to 14,414 tons, which figures have only once been exceeded—in November, 1898, when they were 14,741 tons. For the first quarter of 1899 these exports aggregated 32,009 tons which breaks all records for this season of the year, showing an increase of 33% over exports for the first quarter of 1898. The domestic production does not show the same relative increase, but at 60,441 tons for the first three months of this year establishes a new record. The March production at 21,918 tons has only been twice exceeded—in April and May, 1898, when the figures were 22,909 and 22,741 tons respectively. It is interesting to note that of the United States production for January, February and March of this year, 66% was shipped abroad.

NEW TROLLEYS.—Patents were issued on April 11 to Robert E. Carroll of Lima, Ohio, and Silas T. Leaming, of Wauwatosa, Wis., for improvements on trolleys, the object in both cases being to provide means for preventing the trolley from jumping the line wire at crossings, curves, switches, etc. The first mentioned patent provides for arms pivotally mounted on each side of the trolley wheel, and having at their upper ends grooved guard disks which engage the trolley wire, thereby preventing the wheel from leaving the trolley. A spring regulates the pressure with which the guides embrace the trolley wire. The second trolley device has also the object of preventing the escape of the wheel from the trolley wire, while readily yielding temporarily to obstructions and automatically righting itself after the obstruction is passed. The end of the trolley pole carries a yoke on which are hinged several pairs of upward projecting weighted fingers, the trolley wire being embraced by each pair. The trolley contact device consists of a roller without grooves, mounted in the middle of the yoke, the trolley wire being kept over the roller by the weighted fingers between which the wire passes.

AMERICAN TOWN FOR MEXICO.—Senor Teresa, of the City of Mexico, brother-in-law of President Diaz, and president of the International Bank, is laying out a regular American town site close to the city, to have an electric light plant, electric traction, waterworks, etc., the total cost of the whole thing being estimated at $6,000,000.

PROPOSED HONOLULU CABLE ABANDONED.—At the meeting of the Sandwich Island Cabinet on the 3d inst. the contract with the Scrymser Company for a cable between San Francisco and Honolulu was canceled and the bonds, amounting to $25,000, filed by the concern last year, returned. This action was taken on receipt of a letter from the Secretary of State at Washington, declining to consider the matter.

ELECTRICITY A BACK NUMBER.—A special despatch from Cincinnati of April 15 says: In connection with the despatches from New York that the Standard Oil Company was probably back of the American Incandescent Gas Light Company, it is reported here that among other patents is one for illumination that is expected to supersede the present street-lighting systems as well as those for buildings, and it is stated that a franchise will soon be secured here.

CHICAGO MUNICIPAL ARCS.—A newspaper correspondent in Chicago writes the New York *Times* that plans have been drawn up and part of the machinery purchased for a new electric lighting plant, which will be situated on the South Side. The capacity of the plant will be 1000 arc lights, the cost of the new lights to be $166.86 each a year, which is a reduction from anything as yet operated in that city. They will still be the dearest arcs in the world, but that is not surprising.

BOSTON TO BROOKLYN BY TROLLEY.—Realization of the rate at which trolley lines are spreading over this part of the country can be gained from the fact that a Boston *Herald* reporter has just made a trip from close to his office door to the Brooklyn Bridge, and used electric cars almost exclusively in doing it. He started on Friday afternoon at 5:30 o'clock and reached Worcester at 10. After passing the night at a hotel, he proceeded to West Warren. There he had to resort to the steam railway to Indian Orchard. There was a second break between Warehouse Point and East Windsor Hill, in Connecticut, and a third between Meriden and New Haven. He reached the last-named city Saturday evening and rested again. Next morning he began the long stretch to Stamford. There the railroad had to be taken to New Rochelle, after which it was clear sailing, or trolleying, to the bridge. The trip, including all stops, used up forty-nine hours and cost for car fare $2.30. It will be interesting to see how quickly the trip can be made when it is trolleyed all the way.

A CALIFORNIA FARM TELEPHONE.—The Salinas Valley Land Company has a telephone system, the line of which consists of the ordinary barbed wire that was already on the fences. It is about ten miles long. They use a good telephone instrument. All the connections are made very close, and no wire is connected with the ground in any way, either by hanging down or by touching any other wire that does reach the ground. In crossing roads and gates they took three-eight-inch iron water pipes and laid them under the gates and most of the roads and then ran a rubber-covered wire through them to connect with the barbed wire on each side, bending the ends of the pipe up at the sides of the gates or roads and then filling the ends up with putty to keep water out. This character of telephone line will work just as well as any insulated line in dry weather, but not at all when it is raining. As soon as the posts have time to dry off after a rain it is all right again. It would appear that Californians do not want to talk over the telephone when it rains.

A BIG PENNSYLVANIA TROLLEY SCHEME.—A telegram from Philadelphia of April 15 says: Capitalists of this city are engaged in forming a combination for the control of all the electric traction companies in Pennsylvania outside of Philadelphia. The concern is to be called the Electric Traction Company of America, and it is to be capitalized at $25,000,000. The par value of the stock is to be $50 a share, $5 of which is to be paid in at once. Among those said to be prominently identified with the movement are John Lowber Welsh, Silas W. Pettit, W. H. Shelmerdine and former Mayor Warwick. The head office of the company is to be in Philadelphia. The scheme is entirely local in so far as those interested are concerned, but the presidency of the company will go to A. A. McLeod, formerly president of the Philadelphia & Reading Railroad. The various trolley companies throughout the state have been carefully looked into and data prepared showing the capitalization of each, with prospects for extensions and increased earnings. It was said authoritatively this afternoon that Mr. McLeod had consented to accept the presidency of the company.

ELECTRICAL STEERING MECHANISM.—A patent was issued April 11 to Andrew L. Riker, of New York, for a steering mechanism operated by an electric motor controlled by an ordinary tiller wheel. The principle of the mechanism is similar to that of the usual form of steam-steering gear. In the latter when the rudder has reached a desired angle, as fixed by the motion of the tiller wheel, steam is automatically cut off from the engine and the rudder remains in the desired position. By the present invention the throw of the tiller wheel automatically closes the electrical circuit and sets the motor into operation to turn the rudder, and the motion of the latter automatically operates to break the circuit when the rudder has been moved through an arc proportionate to the throw given the wheel. That is, a slight throw of the wheel causes a slight turning of the rudder, and a greater throw of the wheel a correspondingly greater turning of the rudder. The mechanism is also such that the direction in which the rudder turns depends upon the direction given to the tiller wheel.

NEW CIRCUIT BREAKERS.—Two patents were issued on April 11 on circuit breakers, one to Harry P. Davis, Pittsburg, Pa., and another to Hjalmar Andersson, of Stockholm, Sweden. The former is adapted for both direct and alternating currents, and for any voltage in commercial use, the device being stated to be simple and inexpensive in construction and effective in operation. A fuse is employed as the primary safety device, but is so arranged and combined with other devices as to insure the breaking of the arc with sufficient promptness to avoid injury to the translating devices and to preserve the fuse terminals from material injury. The fuse normally keeps the circuit breaker in operative position against the tension of a spring which, when the fuse melts, throws the switch and breaks the circuit. The second circuit breaker has for its object to remedy the inconvenience from the use of friction contacts and consequent sparking at the same upon the interruption of electrical connection. This circuit breaker consists of two tubes containing mercury and an insulator consisting of a plate of insulating material, which is movable between the tubes to divide the body of mercury. The tubes are in combination with a vessel containing oil, in which the ends of the tubes and the cut-off plate are immersed, the two sides of the circuit being connected to respective ends of the tubes. In one position of the insulating plate, the mercury columns in the two tubes is separated and in another position the columns are united, thus closing the circuit.

ELECTRICAL AUDIPHONE.—A patent dated April 4 has been granted to Mr. Reese Hutchinson, of Mobile, Ala., on an electrical audiphone, the object of which is to provide an instrument to enable deaf people to hear sounds as they are heard by those of normal hearing, and to train the ears of deaf persons to hear even without the instrument. The instrument consists of a microphonic transmitter in combination with a receiver, both being mounted on a convenient handle. The transmitter has two funnels converging toward the diaphragms of the receiving instrument, one funnel being directed to the front of the person and the other to the rear. The receiver is fixed on the handles at right angles to the transmitter, the cover or front piece being turned to form a small hollow cone frustrum at the centre adapted to enter the opening or concha of the ear and focus the sound waves proceeding from the diaphragm. Both the transmitter and receiver are so constructed as to render the instrument not only very sensitive but especially adapted to the particular use to which it is put. The sensitiveness of the instrument is varied at will by means of a device on the handle which is readily manipulated by a finger of the one holding the instrument. The battery for the transmitter is intended to be carried by the user in a belt. The claim is made for this instrument that besides enabling partially deaf people to hear very distinctly, tests having shown that it will also not only enable deaf people to hear but will train the ears of deaf persons to hear even without the instrument.

MULTUM IN PARVO.—Prof. S. P. Thompson once stated that what is wanted is a system of electrical wiring which should be electric-tight, water-tight, gas-tight, air-tight, oil-tight and rat-tight.

MARCONI APPARATUS ON FRENCH CRUISERS.—The French Government has commissioned Signor Marconi to install his apparatus experimentally on a cruiser. If the experiment proves a success several French warships will be provided with the apparatus.

CONSOLIDATION OF ELECTRICAL INTERESTS IN MONTREAL.—It is stated that the various electrical companies doing business in the city of Montreal, Que., in lighting, power distribution and passenger transportation will be amalgamated with a probable capital of from $10,000,000 to $15,000,000.

THE CANADIAN ELECTRICAL ASSOCIATION will hold its next annual convention at Hamilton, Ont., some time in June, the exact date to be fixed later. Representatives of the various electrical companies in Hamilton are taking an active interest in the arrangements for the meeting.

COL. TH. TURRETTINI, of Geneva, Switzerland, has arrived in this country, and recently visited Niagara Falls in company with officials of the Niagara Falls Power Company. It is rumored that his visit has to do with the proposed development of power on the Canadian side by the Canadian Niagara Power Company.

DR. HENRY MORTON, president of the Stevens Institute of Technology, has been advocating the study of "electrology" as the newest learned profession. He says that the high pressure current is the most tremendous power ever placed in the hands of man, and that with it a great future is opening up for the student and the capitalist, as well as for the public that will be benefited.

THE COMMERCIAL SIDE OF THE MARCONI SYSTEM.—A despatch from London, dated April 11, brings the intelligence that the formation of a commercial syndicate is proposed there with the object of acquiring the sole right to establish ether wave communication between Great Britain and the United Sattes under the system of Signor Marconi.

SCIENTIFIC SOCIETY BUILDING.—At the annual dinner of the Scientific Alliance of New York the principal scientific societies of the city were represented. "What is needed now by the Alliance," said N. L. Britton, the secretary, "as it was at the formation of the Alliance, is a building which will serve as a home for the societies, where all their meetings can be held and where their proceedings and lectures may best attract more public attention. The cornerstone for this building has recently been laid by Mrs. Esther Herrman, whose generous gift of $10,000 for the purpose, made to the council, brings the great desideratum nearer than it has ever been before."

WOMAN IN SCIENCE.—Mrs. Ayrton, wife of Prof. W. E. Ayrton, on March 23, read before the London Institution of Electrical Engineers, a paper on the "Hissing of the Electric Arc"—the first paper communicated by a lady to that body. This is not Mrs. Ayrton's first venture in the electrical field, an important paper from her pen on arc phenomena having been printed in a London contemporary in 1895, and at once gave her a high standing in the scientific world. The recent paper is a model of scientific writing, and the experimental gift which it indicates is of a high order, both with respect to conception and skill in execution. An abstract of the paper appears in the *Digest.*

PROTECTING THE RUBBER SUPPLY.—Government after government has prohibited or restricted the collection of rubber in its territory in order to give the plants time to multiply and recuperate. The Congo Free State has now gone a step further. In addition to its decree of 1892, still in force, which made it a serious and punishable offence to kill the rubber plant or to gather rubber in any way except through incisions in the bark, it is now made obligatory to plant at least 150 vines or trees for every ton of rubber collected. Infractions of the new decree are punishable by fine up to $2000, or imprisonment. A Bureau of Control of Rubber Forests has been appointed to guard the rubber interests of the state and to enforce the decrees of 1892 and 1899.

AMERICAN ELECTRICAL APPARATUS IN JAPAN.—In a recent report to the State Department at Washington from United States Consul Lyon, at Osaka, Japan, that official states that the United States has the Japanese market in electrical machinery and that general satisfaction is given by the same. During the year 1897, telegraphic apparatus was imported into Japan as follows: From the United States, $2301; Great Britain, $1102; Germany, $691; but little came from any other country. It is said that considerable delay has frequently occurred in the execution of orders in Europe from Japan for electrical machinery, and that in consequence the American market has been given the preference, with the result that the superiority of such machinery has been fully established there.

GAS ENGINES FOR OPERATING ELECTRIC PLANTS.—Mr. Oliver F. Allen gives in *Progressive Age* the result of inquiries sent to 35 users of gas engines for operating electrical plants. Of 24 replies received, the writers of 15 are entirely satisfied, and have had no trouble, four have had some trouble with igniters, one has had trouble in starting with a cold cylinder, one engine requires too much attention, one is not able to give information on account of engines not running yet, one is doubtful and one is condemnatory. Seventeen of the engines reported are from 125 to 30-hp in size, and the owners of the larger engines particularly express much satisfaction from their use. The gas consumption reported varied from 13.6 to 30 cu. ft. per B. H. P., on the basis of 650 B. T. U. gas. Various makers communicated with guaranteed consumptions ranging from 15 to 20 cu. ft. per B. H. P.

TEST OF POLE INSULATORS.—Careful tests of pole insulators made by Mr. F. W. Jones, electrical engineer of the Postal Telegraph Company, have shown that when newly put up, porcelain telegraph insulators are from four to eight times better than glass, but that along railroads and in cities smoke forms a thin film upon either material indiscriminately, so that at the end of a few months their insulating properties are nearly alike. On pike lines away from railroad tracks, the porcelain insulators maintain a higher insulation than glass in rain, but in fine weather not so high. As a rule in this country, the defect of insulation due to the use of glass insulators is one of the smallest of the difficulties encountered in working telegraph lines. On turnpikes the working is far more seriously impeded by the contact of tree limbs with the wires during the spring and summer, owing to the impossibility of securing the consent of farmers to properly trim the trees. Trees may be trimmed so that their limbs are perfectly clear of the wires in dry weather, but when the branches are loaded with moisture they will bend down and make contact with the wires and stay in that manner until the moisture upon them has been dissipated by the wind and sun. The porcelain insulator is not so liable to be broken by school boys firing stones, and by huntsmen making targets of the insulators, porcelain being not so fragile as glass, but it is very much more expensive.

RAPID GROWTH IN EXPORTS OF MANUFACTURES.—American manufacturers continue to extend their "spheres of influence" throughout the civilized world. The reports of the Treasury Bureau of Statistics show that during the eight months ending with Feb. 28, 1899, the exports of manufactures were not only $37,000,000 in excess of the imports of manufactures, but more than $26,000,000 in excess of those exported in the corresponding months of the fiscal year 1898. In the 204 business days covered by this report, the American manufacturers have exported $207,000,000 worth of manufactures, or more than $1,000,000 worth per day. In the corresponding days of the preceding fiscal year their exportations of manufacturers were only $181,000,000. In the fiscal year 1898, the United States for the first time exported more manufactures than she imported, and the fiscal year 1899 will make another and even better record in this particular. While it is apparent that the imports of manufactures in the year 1899 will be somewhat in excess of those of last year, which were abnormally light by reason of the heavy importations just prior to the enactment of the recent tariff law, the gain in exports is greater than the increase in imports. In the eight months ending with February, 1898, the imports of manufactures were $152,091,157, and in the corresponding months of the fiscal year 1899 they were $169,843,729, an increase of 11 per cent. In the first eight months of the fiscal year 1898, the exports of manufactures were $180,606,072, while in the corresponding months of the fiscal year 1899, they were $206,822,334, an increase of 14 per cent.

NEW YORK STATE CAPITOL.—The bill appropriating $60,000 for the establishment of an electric lighting plant in the Capitol, at Albany, was adopted in the senate last week by a vote of 29 to 20.

SEARCHLIGHTS IN THE ICE.—It is stated from Cleveland that searchlights have proved useful this winter in the heavy ice on the lakes. When they were first placed upon the Detroit and Cleveland steamers they were regarded more as an ornament and advertising medium than anything else, but time and again have the searchlights proved their great value as an actual aid to navigation. With the powerful stream of light from the pilot house the helmsman is enabled to pick his way through the ice fields and much time is saved.

SURVEYING FOR MANILA CABLES.—The United States steamer Nero has been taking on coal at San Francisco preparatory to her departure for Honolulu at the end of this week. The Nero has been entirely refitted and prepared for the work in which she is to engage, the exploration and survey of a route for a submarine cable from Honolulu to Manila. The route between San Francisco and Honolulu having been thoroughly surveyed, the Nero will begin at Honolulu and make soundings from there to the island of Luzon or a midway island and Guam. No soundings have ever been made over this part of the Pacific.

A DIFFERENTIAL ELECTRIC METER.—A patent was granted April 11 to Hermann Aron, of Berlin, Germany, for an electric meter on the differential principle—that is, enabling different rates to be charged during predetermined periods of a day. The amount of current delivered is automatically recorded on two separate dials actuated by trains of wheels, one of which registers differently from the other. At the time set to change from one rate of charge to the other, a tilting frame is automatically shifted so as to disengage the driving counting gear from one recording train and engage it with the other.

ADVOCATING AUTOMOBILES.—With reference to recent remarks in these columns suggesting that electrical people should patronize automobiles and use them freely, the English Motor-Car *Journal* says: "The sermon addressed to those interested in the American electrical industries might well be tendered to British firms similarly situated. Indeed, British firms as a whole deserve the stricture even more strongly than do the American houses. We may say to our contemporary's credit it has never lost an opportunity of advancing the interests of self-propelled locomotion."

ALTERNATING-CURRENT DISTRIBUTION FOR ELECTRIC RAILWAYS.—A patent was granted to E. E. Ries, of Baltimore, Md., on April 11, on an application filed December 30, 1887, on "Apparatus for line distribution by inductional transformers or secondary generators for electric railways." One claim is for a single-phase alternating-current sub-trolley electric railway, the motors being fed from a secondary circuit supplied by transformers along the line, the primaries being connected with a high-potential main circuit. Another claim is for a secondary circuit consisting of a series of normally open working circuits having exposed contact surfaces, and a device on the motor car for closing the working section of the circuits as the car passes.

ELECTRIC ARC-FORMING DEVICE.—In a patent issued April 11 to Josef Czikowski, of Vienna, an electric arc-forming device is described, having for its object the provision of means for striking an arc between electrodes, such as the carbons of an arc lamp, immediately the current is switched into circuit with the lamp. The device consists of a fusible metallic cap interposed between the abutting ends of the electrodes or carbons. As shown in the drawing of the specification, the device consists of a small fusible cone placed upon the point of the positive carbon. The cap is made of such a size as to maintain the carbons at the proper distance from each other, and immediately the current is switched into circuit, it at once fuses and dissipates the metal, upon which the arc is immediately formed between the carbons.

PROFITABLE ELECTRIC LIGHTING IN U. S. OF COLOMBIA.—The Bucaramanga Electric Light Company, of U. S. of Colombia, which has been in business seven years, recently declared a dividend of 12 per cent. on a capital of $115,700, the gross receipts being $25,023, and the expenses but $7527, in which salaries and wages figure to the extent of $5272. The power is derived from the river Surata, by a water wheel geared to a jack shaft. This gearing appears to be a cause of more trouble and expense than all the rest of the machinery put together, and the engineer recommends the use of rope transmission in place of it. The periodical freshets in the river give some trouble, owing to the sand and pebbles and even rocks which the water brings down at such times in sufficient quantities to choke the penstock and stop the service. The plant has 920 incandescent lamps connected and runs a series arc circuit. It has also numerous constant-potential arc lamps on the incandescent system and is gradually replacing such of them as are of the open arc type with the newest enclosed arc lamp to the great improvement of the service. There is a power service, but it is not very satisfactory to either the company or the customers, owing to the small demand and liability to interruption.

TELEPHONE SERVICE IN CANADA.—The Bell Telephone Company, Limited, covers the Provinces of Ontario, Quebec, and Manitoba, in the Dominion of Canada. The cost for telephone service in the city of Montreal is $30 for private residences and $50 for business houses per year. There is no cost for installation and rent. The cost at pay stations in the city is 10 cents for five minutes. The telephone is first located by the company where the subscriber directs; if afterwards the instrument is required to be moved, such removal is done by the company at the expense of the subscriber. The Bell Telephone Company has a long-distance service in the Provinces of Ontario and Quebec, covering hundreds of stations. Its charges for this service for written messages of twenty words or under are as follows:

	Cents.
Up to 15 miles	15
15 to 150 miles	25
150 to 225 miles	50

Charge for delivery is extra. For each additional twenty words, or fraction thereof, one-half the above tariff is asked. The Province of Nova Scotia is covered by the Nova Scotia Telephone Company; New Brunswick, by the New Brunswick Telephone Company: Prince Edward Island, by the Prince Edward Island Company; Newfoundland, by the Anglo-American Telegraph Company. The city of Vancouver, British Columbia, is covered by the New Westminster and Burrard Inlet Telephone Company. Victoria is covered by the Victoria and Esquimalt Telephone Company.

A NEW SYSTEM OF ALTERNATING-CURRENT DISTRIBUTION.—A patent was issued on April 11 to Mr. Charles F. Scott for a system of alternating-current distribution, which is stated to have for its object the provision of a simple, economical and efficient means whereby a source of polyphase currents may be satisfactorily utilized for operating both single-phase and polyphase translating devices. A two-phase generator is utilized for distributing energy over a three-phase circuit, and to operate lights or other single-phase translating devices from two of the conductors of the distributing system, and two-phase or three-phase motors from the three conductors of the system. As illustrated in the specification, an alternator with a delta or closed-circuit armature winding has two opposite points, corresponding to one phase, connected direct to the line, and the other two points, corresponding to the other phase, connected to the primary of a transformer. One end of the secondary of this transformer is connected to one end of the primary and the other end is connected to the third wire of the distributing line. The transformer is so proportioned that the e. m. f. force generated by the secondary winding is that necessary for producing a proper three-phase relation in the three-line conductors, which electromotive force is approximately 36.7 per cent. of the normal electromotive force of the two-phase machine, and also of the three-phase circuit. As illustrated, four varieties of translating devices are supplied from the line circuits. One consists of a three-phase motor with a star-connected winding, connected in the usual way through three transformers with the three conductors of the circuit; another is a three-phase motor with a delta connection supplied with three-phase currents through the intermediary of two phasing transformers; the third is a two-phase motor also supplied through the intermediary of two phasing transformers, and the fourth consists of an incandescent-lamp circuit which is supplied from the two conductors leading direct from the alternator.

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ILLUMINATION.—It is said that the hygienic minimum of illumination is about one foot-candle. At five foot-candles it is quite as easy to read as in daylight. The illumination from daylight is about 80 foot-candles.

THE NATIONAL ELECTRIC LIGHT ASSOCIATION CONVENTION.—Mr. C. O. Baker, Jr., Master of Transportation of the National Electric Light Association, announces that the Trunk Line Association has granted a rate of a fare and one-third, on the certificate plan, from all points in its territory, and return, for delegates and friends attending the twenty-second convention of the National Electric Light Association, to be held in New York, May 23, 24, 25. It is expected that the other railway associations will make the same concession at an early date.

ELECTRIC LIGHTING IN BRUSSELS.—United States Consul Roosevelt, at Brussels, in a report to the State Department, points out the rapid increase in the use of electric light in that city. In 1893 there were 3030 electric lamps in use. At the present time (the report was written in March) there are 66,000. In consequence of the increasing use of electricity the city has been obliged to enlarge its station. It is now proposed to install five new vertical engines of 1000-hp. The city has two plants, and it has been decided to connect them by four cables enclosed in iron pipes. It was proposed at one time to erect a large power house just beyond the city limits, but when it was shown that the loss in transmission would be 15 per cent. the project was abandoned. The most practical method of solving the problem seems to be the erection of new stations as necessities arise.

INDUSTRIAL DEVELOPMENT IN JAPAN.—Mr. J. Yoshii, of Kyoto, Japan, who is at present in this country in connection with the development of the iron and steel industries and importing trade in his native country, states that the railway systems of Japan cover above 5000 miles, with 5000 more projected and under construction. The telegraph and telephone systems are increasing at a rapid rate. In Tokio there are over 10,000 subscribers to the telephone service, each with separate instrument, which is divided into exchanges like the American system. It costs but 40 yen ($20) a year for full local service; 20 cents for a call from Tokio to Yokohama, a distance of 30 miles; $1.50 from Tokio to Kobe, 350 miles. All wire used is American, but all instruments now in use are of Japanese manufacture, based upon the Bell and other American inventions. Copper and iron are very scarce in Japan, so that the United States can have the field if it desires, as American machinery and steel and iron manufactures are preferred. An iron and steel mill is being built on the island of Kushu, but is it not yet in operation, and when it is ready to start most of the pig and ingot metal will have to be imported from the United States.

EXPORTS OF ELECTRICAL MATERIAL FROM NEW YORK.—The following exports of electrical material are from the port of New York for the week ending April 11: Antwerp—29 cases electrical material, $1870. Amsterdam—5 cases electrical material, $200. British Possessions in Africa—3 packages electrical material, $80. Belfast—1 case electrical material, $13. British East Indies—14 packages electrical machinery, $360; 67 cases electrical material, $1403. Berlin—2 cases electrical material, $1090. British West Indies—34 cases electrical material, $1034; 2 packages electrical material, $71. British Australia—50 packages electrical material, $1455. British Guiana—2 cases electrical material, $30. Cuba—3 cases electrical material, $32. Chili—7 packages electrical material, $232. Constantinople—9 cases electrical material, $150. Central America—4 cases electrical material, $150. Dutch East Indies—1 case electrical material, $27. Ecuador—46 packages electrical material, $960. Havre—18 packages electrical material, $818; 4 packages electrical machinery, $300. London—46 packages electrical material, $5764; 4 cases electrical machinery, $217. Marseilles—21 cases electrical material, $2289. Milan—6 cases electrical material, $392. Manchester—1 case electrical material, $180. Naples—3 cases electrical material, $224. Nice—13 cases electrical material, $12,364. Porto Rico—8 packages electrical material, $213. Sandwich Islands—6 packages electrical material, $75. St. Petersburg—7 cases electrical machinery, $139; 9 packages electrical material, $668. U. S. of Colombia—40 cases electrical material, $165; 1 package electrical material, $25. Venezuela—68 packages electrical material, $965.

RARE-METAL INCANDESCENT LAMPS.—We have received a communication from Mr. F. M. F. Cazin, in which the writer directs attention to several patents issued to him, and to applications now pending, covering inventions which are claimed to successfully solve a problem toward the solution of which the lamps of Nernst and others are asserted to be but impracticable attempts. The patents are as follows: Nos. 523,460, 523,461, 566,285, 620,640, 621,291, 621,292, the applications being dated Dec. 7, 1892; July 24, 1893; July 24, 1893; Sept. 11, 1895; Oct. 29, 1895, and Oct. 15, 1897, respectively. In the third patent is claimed a solid body in a vacuum, bearing on its surface lines or films of semi-conductive or carbonaceous matter adapted to become incandescent under current, and also adapted to heat the solid body by means of dark-heat rays produced by the electric current. The main principles of the patents are stated to be "the preservation of the heat produced in the lamp as a means of the utilization of such heat for producing more light, and the selection of successful practical means for evolving further light by means of otherwise dark heat, thus preserved." In one of the patents the better preservation of the heat is secured by providing a lamp with an extra glass housing, leaving a space between the two bulbs, but permitting a small portion of the inner bulb to be unhoused, in which portion there will be condensed the darkened deposits. Another patent is for a compound filament, one constituent being a current-passing filament chemically and electrically insulated from an outer or luminous portion by an intermediate stratum. Still another patent claims a luminous body consisting of "two or more cohesive parts, namely, an inner filament part and an outer part or parts, which mainly consist of refractory rare-metal oxide, such outer part or parts covering the inner part in part only." Another claim in the same patent is for a three-part luminous body, "consisting of an inner core and filament, an insulating stratum on such core, and an outer partial cover of pseudo fabrics of rare-metal oxide." Applications are pending on the use of only two luminous oxide bodies on the protected and insulated core, and also for a plurality of smaller oxide bodies, made by "winding pseudo-oxide-fibre around the core and forming bridges over the interceptions of the insulating stratum, the whole resembling, when under current, a string of fiery beads."

LETTERS TO THE EDITOR.

The Wehnelt Interrupter.

To the Editors of Electrical World and Electrical Engineer:

I have read with a great deal of pleasure the articles on the electrolytic interrupter which appeared in your periodical. I regret to state, however, that I am not in a position to send you an account of my latest experiments with the device, as the matter is in the printers' hands at this moment. The patent rights for the United States have already been applied for, and the Union Elektricitats Gesellschaft is arranging for the rights to manufacture the interrupter in the states. I am astonished that Prof. Elihu Thomson has not as yet employed adjustable electrodes for use in the interrupter. The firm of Ferdinand Ernecke, Berlin, builds interrupters with adjustable electrodes, and no other kind is made here, they having exclusive rights.

DR. A. WEHNELT.

CHARLOTTENBURG, BERLIN.

The Nernst Lamp.

To the Editors of Electrical World and Electrical Engineer:

Sirs—Possibly some of your readers may be interested in a very simple method of demonstrating the principle of the Nernst lamp. In order to make the experiment, it is only necessary to secure a short piece of the small end of an ordinary clay pipe stem an inch and a half or two inches long, and fix its ends in holes bored in two small pieces of arc-lamp carbons, wind a wire around each of the carbon blocks and attach them to the terminals of a step-up transformer, which should have a rheostat included in its low voltage side. It is necessary to use 2000 volts to cause the current to start, and to then reduce the voltage by means of the rheostat. An ordinary lineman's soldering torch suffices for the heating, which may require several minutes.

When the current has once started, it is possible to regulate the degree of incandescence so that the lamp will burn for a considerable time with a fair degree of brightness, and it is only when the

heating is carried to full whiteness that the conductor begins to sag, fuse and at last to open the circuit. It really makes quite a good lamp for some little time if not overrun, and at least demonstrates the principle involved very prettily.

ALBERT L. CLOUGH.

MANCHESTER, MASS.

The Dimensioning of Armatures.

To the Editors of Electrical World and Electrical Engineer:

Sirs—The article by George T. Hanchett in the ELECTRICAL WORLD AND ELECTRICAL ENGINEER of March 11, is subject to a slight criticism, which I venture to make.

In his demonstration to find a shape of surface which will have the least perimeter for a maximum surface, he assumes that the distance around the surface = 2 (length + 2 (breadth). This is only true in the case of a rectangle. Although he has proved that the square is the rectangle having least perimeter for a maximum surface, he has not found the figure fulfilling the conditions far, as every geometry proves the circle is the correct answer.

Now this leads us to the conclusion that the wire on the ends of an armature is no more "dead" than that on its circular surface. In fact, it is just as foolish to call the "end wire" dead as it would be that on two sides of a transformer secondary coil, calling that on the other two faces only, active. Both cut relatively changing lines of force.

When we remember the T.-H. arc dynamo with circular armature, especially the old style drum one, we can see the pertinence of the preceding.

The only dead wire on the armature then, is the leads to the commutator segments.

A. M. KENNEDY.

MOBILE, ALA.

Two-Phase vs. Three-Phase Systems.

To the Editors of Electrical World and Electrical Engineer:

Sirs—Referring to your editorial on the relative merits of two-phase and three-phase systems of power transmission, in my opinion, the system for any particular case should be chosen with reference to the work to be done. No hard or fast rule can be laid down for this question any more than for that of frequency. In general, I would use two-phase for distribution of light and power from a station situated comparatively near the consumers; this whether the station be a generating station or a sub-station into which power is brought by a transmission line.

In the case of a sub-station with the generating plant at some distance and transmission at high voltage, I would use a three-phase transmission, step-up transformers if any being three-phase, and stepping down from the higher voltage and three-phase to the lower voltage and two-phase for lighting and small power consumers, but would probably step down to three-phase for large consumers of power.

One advantage of three-phase with three transformers is not touched upon in your editorial. This advantage is that the failure of one transformer is less serious than such failure in the case of transformation with two transformers only. This advantage, however, is present only when the three transformers are connected in delta fashion, which is the connection I prefer.

RALPH D. MERSHON.

NEW YORK. N. Y.

Nature of the Lightning Discharge.

To the Editors of Electrical World and Electrical Engineer:

Sirs—I was much interested in the reproductions of photographs accompanying Dr. Morton's article on the spiraling and vibratory nature of lightning.

Before reaching a conclusion in regard to the rotary effects obtained in certain lightning discharges, I think it will be necessary to carefully study the behavior of the lenses employed, and the angle at which the lightning is photographed. I find that I can obtain the rotary effects and spiraling by putting a constriction lens out of focus and receiving the electrical discharge obliquely.

JOHN TROWBRIDGE.

CAMBRIDGE, MASS.

To the Editors of Electrical World and Electrical Engineer:

Sirs—The hypotheses, or suggestions, made by Dr. W. J. Morton, as to the nature of the electrical discharge and his explanations of the appearance of the electric spark, as seen in photographs, do not seem to me at all satisfactory. I cannot think it probable that a discharge consists of two parts traveling in opposite directions, moving in opposite spirals around each other. There is doubtless motion between the electrodes, or the ends of a discharge of lightning, and also a transverse movement along the discharge at every point of its path, but the *spiral rotation*, if it exist, must be an incident in some special case and not a general phenomenon. The explosive expansion of the gases and vapors along the path would fully explain both the regularities and the irregularities of all the photographs of lightning that I have thus far seen.

CLEVELAND ABBE.

WASHINGTON, D. C.

To the Editors of Electrical World and Electrical Engineer:

Sirs—I cannot agree with Dr. Morton altogether. The Milne photograph is familiar to me and I think I wrote several months ago a statement of why I thought the result to have been produced either by a movement of the camera or by a strong wind nearly in the line of the discharge, probably the former. With regard to the other picture, namely, that the high tension alternating current arc (Siemens) I think that the spiraling would be accounted for by air currents or rather heated gas rising in the air. The initial direction of the twist may be determined by accident or by pre-existing air currents, or even, less probably, by the earth's magnetism. Since the arc is one formed by alternating currents it is difficult to see why the spiraling should have a definite direction due to direction of flow of current which reverses rapidly. Uprising air currents can, however, produce the effects shown. Personally, I much prefer the simpler explanations given above than those which assume actions as yet unknown or unproven. There may be conditions under which discharges take the spiral course suggested by Dr. Morton, but that many or most of them give little or no evidence of such an action I think is true.

The phenomena of electric spark and also those of high potential arcs certainly need more complete and careful study than has been given to them. Methods could doubtless be devised for investigation which would add considerably to our present knowledge in this fascinating field.

ELIHU THOMSON.

SWAMPSCOTT, MASS.

The Need for Economic Data of Power Transmission Plants.

To the Editors of Electrical World and Electrical Engineer:

Sirs—It was with much pleasure that I read the very interesting article, in your issue of this week, by Mr. Maccoun upon the use of electric motors in a steel works, and I hope that it may be but the beginning of a series of similar articles, for it seems to me that right now more real interest in the advantage and economy of electric power transmission is being manifested than at any time since the electric motor became a recognized important factor in the economy of manufacture.

Now that our long expected return of prosperity in the commercial world is an accomplished fact, and our mines, mills, factories and all other industrial establishments are running on full time or overtime, it is but natural that the manufacturer should begin to give serious consideration to the enlargement of his plant, to the modernization of its equipment or to the reduction of his fixed operating expenses for the purpose of either further increasing his dividends or of enabling him to meet more profitably the competition of his more progressive competitors. That the manufacturer is rapidly becoming a convert to the safety, convenience and economy in the use of electric power in his manufactory is evidenced by the gratifying number of such concerns, which, as those in the trade know, are now being electrically equipped. Yet the majority of the manufacturers are undoubtedly skeptical of the sav-

ing which may be effected through the substitution of the electric power system for other better known and tried systems. What they want, and are constantly asking the builders of electrical machinery for, are data and figures relative to the saving which electricity may effect for them; in short, facts are what they want, and preferably those which have been gathered from the results of others who have been more progressive and have made the trial. Unfortunately for such manufacturers, and especially so far the builders and sellers of electrical machinery, such data as they who are considering the installation of considerable electrical machinery want is not only scarce, but what little there is seems difficult for them to secure. Many of the users of electric motors on a scale worth considering who have made their own tests, comparisons and figures and have arrived at the economy effected, have done so for their own information and are naturally somewhat loath to make public the facts, while the consulting engineers and electrical machinery builders as naturally hesitate to give out their hard-earned data.

Of course, I am not referring to any difficulty in arriving at the cost of operating a factory with central station service, for here the monthly bill tells the tale full well, but what I particularly refer to is the comparative cost of operating plants with the old-fashioned and the newer electric systems, or, at least, the reduction in the power consumption.

If Mr. Maccoun had but given us, in his article, some figures and facts as to the saving which had been effected in the mill he writes of, how convincing it would have been to many of the manufacturers who are still "on the fence!"

I would call your attention, as editors of a technical and trade paper and as publishers of works treating upon the practical applications of electricity, to the fact, which may so far have escaped your notice, that there has not been published a single American work nor a great many articles upon the subject of the various systems of power transmission in factories and their comparative costs. I would suggest that you use your efforts toward having such scattered data on this subject as exist collected and published for I am sure that such would not only prove interesting reading, but would materially assist in extending the use of electrical apparatus and materials.

I would also suggest that to either the experienced mechanical and electrical engineer or the young engineer who is considering which branch of his profession to make a specialty of, no field seems more promising just now than this of electric power transmission equipments for manufactories; and he will be the most successful who has the most facts and figures to submit to his client.

Campbell Scott.

New York, April 14, 1899.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

By CARL HERING.

Dynamos, Motors and Transformers.

Three-phase Motors with Large Starting Torque.—In a recent paper by Macher, reprinted in the *Elek. Zeit.*, March 30, he discusses the question of three-phase motors having a large starting torque and capable of standing a large overload; he endeavors to show in particular how with the same iron frame these properties can be given to a motor. He shows analytically that the maximum output, torque and starting torque, are inversely proportional to the first and second power of the impedance, and it is therefore necessary to make the impedance as small as possible in order to obtain these results. He shows that to regulate a motor with a short-circuited armature by placing resistances in the stator circuits, is a very bad method; by putting the resistances in the rotor circuits, however, the impedance may be made small without weakening the starting torque. In order to show the effect on these properties of a motor, of lowering the impedance, he made some tests on a motor on which he changed the number of windings on the stator in the ratio of 4 to 3, testing the motor under both conditions; the results are given in curves and tables for both cases and it is shown that the resistance and impedance for no load were reduced almost to a half; the best efficiency and power factor is then at double the load while the maximum torque increases in proportion to the decrease of the impedance. The exciting and no load current also increased in proportion to the decrease in the impedance. The maximum output of the motor at the point when the speed will fall rapidly was 3.8 fold, and the motor will start with a load representing five times that at normal speed and load. The curves showing the dependency of the output and the torque, on the current, show that for the modified motor at the same current strength, both of these have increased to more than double. The reactance has increased about twofold and the inductance has diminished in about the same proportion. Some similar tests are given briefly for a smaller motor. He shows that for every size of motor there is a particular reactance and inductance which may be considered characteristic of it; the table of these constants for various motors is given. It is assumed that the air space remains constant; by increasing it the reactance may also be diminished, but this is objectionable, as the cosine of the angle of lag then becomes less.—Marcher. *Elek. Zeit.*, March 30.

Regulation by Means of a Third Brush.—Some time ago Mr. Sayers described a proposed system of regulating the voltage of a dynamo by exciting the field magnets from a current obtained from one of the main brushes and a third brush placed not far from the other main brush (see Digest, July 30); in this way the voltage is said to remain constant for all loads, as in compound machines, and it may even be used for overcompounding. Mr. Feldmann in the *Elek. Zeit.*, March 30, describes very extended researches made to determine the various properties of a machine thus constructed, and to investigate the subject of sparking at the third brush, which is made of carbon. He found that by placing the third brush in various different positions the excitation current would fall with the load in one position and rise in another. The unsymmetrical field thus produced and other conditions led to the belief that there would be sparking at the third brush, but this he says was not the case with the machine which he tested. The results of his tests are given in numerous curves and the sparking conditions are discussed algebraically. He concludes that the Sayers method showed itself to be applicable in all cases, and while the third brush involves some mechanical complications, there are no electrical ones. The only objection which he mentions is the possibility of an opening of the exciting current due to the failure of the third brush.—Feldmann. *Elek. Zeit.*, March 30.

Theory of Converters.—Mr. Guilbert in *L'Ind. Elec.*, March 25, points out what he believes to be an error in the recent paper of Kapp (see Digest, Oct. 15, 22; Dec. 10). On the basis of equal heating of the armature and for various power factors. Kapp gave outputs which Guilbert claims are higher for three-phase currents than those obtained in practice; this difference is so great that the correctness of the formula is doubted. This is discussed mathematically by Guilbert with the aid of the formula of Woodbridge and Child, published in the Elec. World, Jan. 2, 1898, and he obtains the following as the corrected value. For the theoretical case of a sinusoidal field the relative output as compared with that when used as an ordinary continuous current dynamo is 85 per cent.; when the breadth of the pole is two-thirds of the distance between them it is 89 per cent., and when it is half the distance between them it is 95 per cent., the power factor in each case being unity. When the cosine of the angle is 0.9 these figures are 74, 77 and 84 respectively. A table of figures for various angles and currents is given; they are considerably lower than those of Kapp, but are said to correspond well with those obtained in practice.—Guilbert. *L'Ind. Elec.*, March 25.

References.

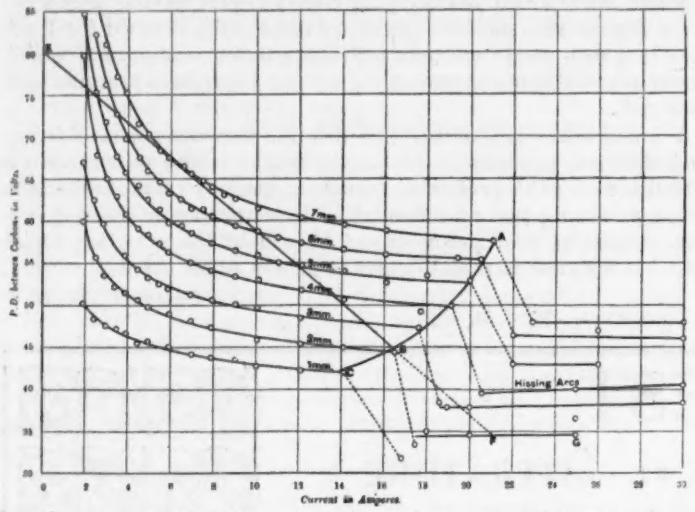
Theory of Single-phase Motor.—The continuation of the article on oscillatory and rotary magnetic fields and the theory of the single-phase motor (see Digest, March 4). He discusses the squirrel-cage rotor and describes graphically the relative magnitudes of the forward and backward fields.—Field. Lond. *Elec. Rev.*, March 31.

Alternating Current Motors with Great Starting Torque.—A long illustrated abstract of the article which was noticed in the Digest, July 9.—Deri. *L'Eclairage Elec.*, March 25.

Lights and Lighting.

The Hissing of the Electric Arc.—Mrs. Ayrton recently read before the English Institution of *Elec. Eng.* another one of her very inter-

esting papers describing a most exhaustive investigation of the hissing arc, the results of which are of value to those experimenting with arc lamps. A reprint is begun in the Lond. *Elec.* and *Elec. Rev.*, March 31. Only a few of the more important conclusions can be given here. The paper refers to the direct current open arc. Of the noises produced two are of importance, the hum and the hiss, which are connected with one another, as the former occurs only when the arc is on the point of hissing or has just been hissing; in the paper she discusses the arc as it passes from the silent to the humming and from the humming to the hissing state. The adjoining figure for open arcs with solid carbons, positives 11-mm and



negatives 9-mm, show the connection between the difference of potential at the carbons and the current for various constant lengths of the arc. In these experiments the lamp was run until it was quite normal, before the measurements were made. From these it was found that when the length of the arc is constant and the arc silent, it may be made to hiss by increasing the current sufficiently; the largest current that can maintain a silent arc is greater the longer the arc; when the arc begins to hiss the voltage suddenly falls about 10 volts and the current rises 2 to 3 amperes; when the current is constant and the arc silent, shortening the arc will make it hiss; for the hissing arc the voltage is constant for a given length of arc whatever the current. The curves show that just before the hissing begins there is an unstable state shown in dotted lines. Luggin has shown that however long the arc it would still hiss when the current increased sufficiently. Prof. Ayrton has shown that the voltage at the carbons becomes quite constant for wide variations of the current with the hissing arc, as is shown by the fact that those portions of the curve in the adjoining figure are horizontal lines. He also showed that the largest current that would flow silently with any given length of arc is increased by using thicker carbons. Other similar figures show that the law of variation is different for solid and cored carbons, but for the hissing arc all the lines are straight and nearly parallel showing that the voltage is the same for a given length of arc whatever current is flowing and whether the carbons are cored or solid. For each pair of carbons the current that will sustain a normal silent arc has a maximum value and any current greater than this will make the arc hiss however long it may be. She gives a simple equation connecting the voltage with the length of the arc when hissing, the curve being a straight line, and shows that with the hissing as with the silent arc, a straight line law connects the voltage with the length of the arc. For silent arcs, however, this holds only for a constant current or for those at the hissing points, while for hissing arcs it applies to all currents. Hissing only starts when the current is greater than it can be with any silent arc of the same length. Another equation shows that the longer the arc the less does the voltage diminish when it changes from silence to hissing. Of the total diminution of the voltage of the carbons caused by hissing, about two-thirds takes place at the junction of the positive and the arc and the remaining third seems to be due to the lowering of the resistance of the arc itself. When the largest silent current changes to the smallest hissing current for the same length of arc, the value of that smallest hissing current depends also on the e. m. f. of the generator; the smaller the latter the larger will be the value of the smallest hissing current. Mrs. Ayrton. Lond. *Elec.* and *Elec. Rev.*, March 31.

The discussion is abstracted briefly in the Lond. *Elec. Rev.*, but contains nothing of importance.

Interior Illumination by the Arc Light.—A recent paper by Mr. Utzinger is abstracted at some length in the *Zeit. f. Beleucht.*, March 20. It is devoted chiefly to the question of the distribution of the illumination in interiors. In order to measure the light lost by a globe he measured it at all angles both with and without the globe, as a measurement in only one direction in the two cases gives entirely incorrect results, the light being more uniform with the globe. The only way to make a correct comparison is to compare the mean spherical intensities of the light with and without the globe; these he found to be 320 with the globe and 360 without, giving as a quotient 0.98 representing a loss due to the globe, of 11 per cent; this is much less than is usually assumed. A number of curves are given showing the illumination on the floor under various conditions; with the globes it is of course much more uniform. When still greater uniformity is required the arc may be reversed, the positive carbon being at the bottom; this may either be used with a globe so that the light reflected on to the ceiling is first diffused and that passing out of the lower part of the lamp is only diffused and not reflected; or it may be accomplished by means of a reflector below the lamp which reflects all the light to the ceiling. The illumination curves for all these cases are given. Such reversed lamps, however, are apt to burn unsteadily as particles fall into the crater, therefore when great constancy is required the arc had better not be inverted even though the loss by reflecting the greater portion twice is somewhat greater. The uniformity of illumination can in this way be made greater than that of daylight, owing to the fact that the latter is limited by the windows. A hall 13.6 meters long, 7.10 wide and 3.5 high was lit with two lamps of 12 amperes with the usual arc (not inverted), but with a reflector below it, the light therefore all coming from the ceiling, and it was found that the mean illumination was 66.5 meter candles; the hygienic minimum is said to be 10 meter candles and at 50 meter candles, according to Kohm, it is quite as easy to read as in daylight; it is therefore seen that the illumination is quite ample. The smallest illumination was 26.5 per cent. below and the largest 25 per cent. above the mean. Measurements made in daylight when the sky was slightly clouded gave a twelve times greater illumination but the uniformity was much less than with artificial illumination, the lowest being 55 per cent. below and the highest 69 per cent. above the mean. Enclosed arcs are not to be recommended in general for interior illumination; in these the positive carbon has no crater and the arc therefore continually changes its position; with the application of a reflector (presumably meaning below the lamp, as described above) these differences can be greatly diminished and those lamps can then be used in many cases for interior illumination. Concerning the cost or indirect lighting, by reflection from the ceiling, he states that the loss by reflection is from 35 to 40 per cent., but it should be remembered that arc lamps cannot be used without globes, which absorb from 10 to 15 per cent., thus leaving the relative loss only 20 to 30 per cent. Owing to the greater uniformity of the illumination, however, the amount of light required is less and there is therefore no appreciable difference in the cost of direct and indirect lighting. He gives a table for estimating the energy required for interior illumination with open reflectors, meaning presumably indirect lighting with the usual arc lamps of 8 to 12 amperes and a height of ceiling of about 4 meters; for a 10-meter candle it is 2.4-watt per sq-m; for 20 it is 3.5, for 40 it is 6.7, for 60 it is 10.7, for 80 it is 16.4; these figures are of course only approximate and are for continuous currents; for alternating currents the energy is 33 per cent. greater.—Utzinger. *Zeit. f. Beleucht.*, March 20.

Three Arcs in Series on 110-Volt Circuits.—In a paper by Mr. Zeidler, reprinted in the *Elek. Zeit.*, March 30, he calls attention to the necessity of an external dead resistance when arc lamps are run on 110-volt continuous current circuits, notwithstanding that this wastes about 25 per cent. to 30 per cent. of the energy in that circuit; usually only two lamps can thus be run on such incandescent light circuits; it has been tried to reduce this resistance, but lamps of the ordinary construction are found to require it. He then shows that by means of the differential arc lamp made by the General Electric Co., of Berlin, this lost energy can be reduced to but a few per cent., and that the light will be steady enough for most purposes; in this case three instead of two lamps may be connected in series on such circuits. This is possible owing to the fine regulation of those lamps and to the quick adjustment of the arc to correspond with variations in the current. These lamps are provided with a starting resistance which is divided into various steps and is cut out automatically by a core in the solenoid through which the main current passes; this resistance is found necessary for starting the lamps. A

diagram and external views of these lamps and regulators are given, as also some curves showing the fall in voltage with an increase of the current, for each of two lengths of arc; these show that for a constant length of arc the voltage falls quite appreciably as the current rises. These lamps have been running in large numbers in Berlin for a number of months. The amount of light obtained is shown to have been increased in the ratio of 3 to 4 as compared with two lamps and a dead resistance. A space which formerly required 12 lamps then requires but 9 for producing the same illumination and with less energy. The same lamps can also be used at higher voltages; for 220, for instance, either six lamps at 35 or five at 42 may be connected in series, and the gain in light in the latter case will be 25 per cent. greater than in the usual case when four lamps are in series; in that case they prefer the use of a dead resistance which is in circuit for about a quarter of a minute when the lamps are first lit, and is then cut out. The quality of the carbons is a very important factor in such lamps.—Zeidler. *Elek. Zeit.,* March 30.

Train Lighting.—The Dick system is described at great length in a paper by Mr. Dick, reprinted in the *Zeit. fuer Elek.,* March 19 and 26; it is being introduced by an Austrian company. Every train has a single dynamo and every car is provided with a battery of accumulators; the regulating apparatus is in the car containing the dynamo which is driven from the wheel axles. When the speed is not less than 20-km (12 miles) per hour the dynamo alone supplies all the lamps with current; it is only when the speed falls below this or when the cars are at rest that the lamps are supplied from the accumulators; any excess of current from the dynamo is stored in the batteries. The accumulators will therefore be much smaller and lighter than if they provided the whole of the lighting. The dynamo is excited from the batteries and the regulation is produced entirely by the adjustment of the exciting current. A diagram of the necessary regulating apparatus and commutator is reproduced and appears rather complicated; there are three wires running along the train, the third one being for operating a mechanism on each car. Each car has 36 cells of 40 ampere hours capacity, and will supply all the lamps of a car for eight hours. Among the advantages claimed are that the batteries need not be handled, they are not forced, not much attention is required, and the cost is said to be very favorable; detailed items of the cost are included.—Dick. *Zeit. fuer Elek.,* March 19 and 26.

Light Emissive Power of the Rare Oxides.—In connection with the idea of using the oxides of the rare earths as coatings for the filaments of incandescent electric lamps, a French Physical Society paper by Bunte, abstracted in *Science Abstracts,* February, may be of interest. He found that the lighting power of the mantels of Welsbach lamps is not due to any special emissive power, proving it by observing the emissivity of the oxides of thorium, cerium and magnesium, and of retort carbon heated in an electric furnace to a temperature of about 2000°. The lighting power is simply the result of a high temperature to which the mantel is raised and is due to the catalytic properties of the oxides of cerium and to its fine subdivision. The presence of this oxide lowers the temperature of combustion of a mixture of oxygen and hydrogen from 650° to 350°, and the combustion is consequently strongly active in the neighborhood of the mantel, therefore disengaging a large quantity of heat. (As it appears therefore to be a question of combustion and not of any particular power of emissivity, there seems to be no reason to expect favorable results by using such oxides with the films of incandescent lamps).—Bunte. *Science Abstracts,* February.

REFERENCES.

Three Arcs in Series on 110 Volts.—A very long abstract, with illustrations and tables of the article noticed in the Digest, Feb. 11.—Wedding. *L'Ind. Elec.,* March 25.

Vitiation of the Air by Illuminants.—Some figures showing the air consumed and heat set free by different forms of illuminants.—Buse. *L'Elec.,* April 1.

POWER.

Notes on Mining Practice.—In a long article in the *School of Mines Quarterly,* January, Mr. Hildburgh describes a number of mining plants which he visited in Northern Michigan, in some of which electricity is used. At the Lake Angeline iron mine all the haulage in one shaft is electrical by means of locomotives of 30-hp hauling trains of five cars and capable of exerting 1500 pounds pull at 8 miles per hour; as many as 20 loaded cars, 4.25 tons each, have been hauled and the locomotives are operating very satisfactorily; 500 volts is used. The lights are run five in series. The haulage at the lake shaft of the Cleveland Iron Mining Co. is also done by electric locomotives, which he describes briefly.—Hildburgh. *School of Mines Quarterly,* January.

REFERENCES.

Lachine Rapids Plant.—A brief extract from the annual report is published in the *Can. Elec. News,* and shows a net profit of $33,000. The principal profit is derived chiefly from a few hours lighting out of the twenty-four.—*Can. Elec. News,* March.

Refuse Destructor.—A brief illustrated description of the Horsfall destructor with some extracts of reports by Lord Kelvin and Prof. Barr.—Lond. *Elec. Rev.* March 31.

TRACTION.

Suburban and Metropolitan Electric Traction.—The report of Mr. Dawson's paper (see Digest last week), is concluded in the Lond. *Elec.,* March 31; a reprint is begun in the Lond. *Elec. Rev.* He shows that electricity is a cheaper method of operation that steam locomotives. On English roads 3 to 4 lbs. of coal are consumed on the locomctives per indicated hp hour and on an average of 400-hp for a locomotive a train weighing 250 tons at 40 miles per hour, the most economical rate is about 0.65 lbs. of coal per ton mile; under favorable conditions, it would not take more than 3 lbs. of coal to give a kw hour at the switchboard; stationary engines of 4000 to 6000-hp could be guaranteed to consume not less than 12 lbs. of steam per indicated hp hour. In a large station few men would be required and the cost of power would be reduced to less than one cent per unit, including expenses of every kind. On the Brooklyn City Railway Co. the total cost of a unit at the switchboard, including everything, is 0.52 cents and the cost of coal 0.23 cents. In another case the cost of coal is 0.27 cents per unit at the switchboard, or, including everything, 0.59. In another case, with a Corliss engine, the average per year per indicated hp hour was 1.65 to 1.76 lbs. of coal. With a good Corliss engine in one American station the coal consumption was reduced from 8.3 to 4.9 lbs. of coal per car mile. On the Chicago elevated lines from 0.116 to 0.135 units are required at the switchboard to drive the trains at an average speed of 13.5 miles per hour and a maximum of 28 to 35. Considerable similar and other data for American lines are given. In conclusion he makes a few remarks on bonding; in his opinion the bond should be flexible, contain no solder or brazed joint, should be expanded against the side of holes in the web or foot and held in place by pins. Such bonds when properly applied, he states, can be absolutely relied upon.—Dawson. Lond. *Elec.* and *Elec. Rev.,* March 31.

Operating Statistics of European Railways.—L'Eclairage Elec., March 25, reprints from the *Jour. Officiel,* Dec. 27, two double page tables giving well filled columns of operating statistics of French electric railways for the first half of the years 1897 and 1898. Besides the length and original cost, it gives the receipts and expenses, their ratio, and the receipts per kilometer per day. The total length of lines represented is 292-km, of which 7 use the Claret-Vuilleumier system, 4 accumulators, 9 the rack and pinion and the rest the overhead trolley wire. The same data for some compressed air lines is also given.—*L'Eclairage Elec.,* March 25.

REFERENCES.

Electric Traction in Great Britain.—An article dealing with the commercial aspect of this form of traction in Great Britain. He points out the difficult conditions to be met and discusses the tendency to municipalizing.—Garcke. *Eng. Mag.,* April.

Electric Tramways in Liverpool.—A map of the proposed electric tramways in Liverpool. The city has ordered twenty electric cars, eight 1200-hp engines, five compound and three triple-expansion, with generators.—*St. R'y Jour.,* April; Int. Ed.

Alexandria Park Tramway of London.—A brief illustrated description. The line is about 600 yards, with an average grade of 1 in 14 and a maximum grade of 1 in 9.75. There are two cars, equipped with two 25-hp motors each.—Tester. *St. R'y. Jour.,* April; Int. Ed.

Blackburn.—An illustrated description of the tramway system.—Lond. *Elec.* and *Elec. Rev.,* March 24.

Bahia.—A short illustrated description of a street railway in Brazil; built by German contractors.—*St. R'y Jour.,* April.

The Breakage of Car Axles.—A short article with illustrations of some fractures.—Thompson. *St. R'y Jour.,* April.

Vestibuling of Cars.—A letter addressed to the Committee on Railroads of the New York State Assembly arguing against vestibules on front platforms.—*St. R'y Jour.,* April.

A Cheaply Constructed Snow-Plow.—An illustrated description.—Hawkins. *St. R'y Jour.,* April.

Traveling Platform For the Paris Exposition.—Another brief

illustrated description of this platform which was referred to in the Digest, April 8.—*L'Elec.*, March 25.

An illustrated description of the experimental installation at St. Ouen, near Paris, on which the one for the Exposition is to be based, is published in the *Sc. Am. Sup.*, April 8.

Electric Locomotive.—A brief illustrated description of the contractor's locomotive for the Baker St. & Waterloo Railway, which was recently mentioned in the Digest.—*Sc. Am. Sup.*, April 8.

Design of Automobiles.—The second portion of the article noticed in the Digest, April 8. The author describes with illustrations various transmission devices from the motors to the wheels, as also the starting devices.—Lavergne. *Rev. Gen. des Sciences,* March 15.

Motor Carriage Design.—The beginning of a much longer abstract with illustrations, of the paper, a notice of which was referred to in the Digest, April 8.—Parker. Lond. *Elec. Rev.*, March 24.

Submarine Boats.—Illustrated descriptions of the French boats "Gymnote" and "Gustave Zédé," in both of which electric power is used.—*Sc. Am.*, April 8.

Railway Brake.—Brief descriptions of several electric brakes.—Lond. *Elec. Eng.*, March 24.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Brighton.—The beginning of an article descriptive of the development of this central station.—Lond. *Elec. Rev.*, March 31.

Accumulator Switch.—Brief illustrated descriptions of magnetic cut-in and cut-out switches for charging accumulators.—Lond. *Elec. Eng.*, March 24.

WIRES, WIRING AND CONDUITS.

Temperature Coefficients of Copper.—A brief abstract is given in the Lond. *Elec. Rev.*, and more briefly in the Lond. *Elec.*, March 31, of a set of tables by Clark, Ford and Taylor, who have carried out a series of tests on six samples of copper wire supplied by five of the largest wire manufacturers, presumably of Europe. They found that the temperature coefficients were almost identical, but differed to some extent from Matthiessen's standard. Their formula is that the ratio of the resistance at any temperature to that at 32° F. is equal to the following: $1 + 0.0023708\ (t-32) + 0.0000003458\ (t-32)^2$. They have published these in book form together with useful tables giving the resistances at various temperatures.—Lond. *Elec. Rev.* and *Elec.*, March 31.

Uninsulated Neutral with 440 Volts.—A note in the Lond. *Elec.*, March 31, states that a station has been installed at Bonn, Germany, in which the three-wire system is used with 220 volts on each side and in which the neutral wire is bare. It was recently started and has a connection of 24,000 lamps of 8-cp. There are at present two steam dynamos of 250-hp and a battery of accumulators.—Lond. *Elec.*, March 31.

REFERENCES.

Line Constants for Power Transmission Circuits.—A reprint of what appears to be a very convenient table used in the engineering department of the General Electric Co., giving the resistance, inductance, charging current and reactance for the various sizes of wire commonly in use, per mile and per thousand feet.—*Eng. News,* April 6.

Interior Wiring.—A reprint of a paper describing with the aid of illustrations, the modern systems of interior wiring.—Chubbuck. *Can. Elec. News* March.

French Wiring Rules.—An abstract of the new rules issued by the French Chambre Syndicat.—Lond. *Elec.*, March 31.

ELECTRO-PHYSICS AND MAGNETISM.

Sensitive Coherer.—In an Academy note by Mr. Tommasina, reprinted in *L'Ind. Elec.*, March 25, he claims to have found by enclosing the coherer in mercury, that electric waves do not act directly on the filings, but that the latter become conductive by the action of extra currents induced by the waves in the metallic conductors connected to the coherer. He also shows that it is possible to make a coherer with carbon powder, which is as sensitive as the best coherer with metallic filings, and it has the advantage that it loses its conductivity with the slightest shock. He constructed another form which he found to be extremely sensitive; it is made of two arc lights carbons rounded at the ends, lightly brought together in a glass tube; it seems to require a little time to get into good working order, but it then forms a very satisfactory and sensitive coherer. He then describes experiments to find whether the human body is also the seat of extra currents induced by electrical oscillations.—Tommasina. *L'Ind. Elec.*, March 25.

Canal Rays.—Some investigations by Wehnelt are described in the *Wied. Ann.* No. 2, abstracted briefly in the Lond. *Elec.*, March 31, with a mica cross introduced into the dark cathode space casting a shadow on the anode but not on the cathode. The shadow is independent of the distance between the cross and the cathode provided the former remains within the dark cathode space. There are no canal rays in the region covered by the shadow, on the other side of the perforated cathode, which confirms the view that canal rays are simply anode rays which are not intercepted by the cathode. He thinks it very probable that no cathode rays are given off except where anode rays impinge, thus making them the primary phenomenon.—Wehnelt. Lond. *Elec.*, March 31.

Visibility of Roentgen Rays.—Mr. Dorn, whose experiments with the effect of Roentgen rays on eyes have been noticed before, describes some further researches in the *Wied. Ann.* 66, p. 1171, with totally color blind persons in which he found that such eyes may be very sensitive to Roentgen rays. In the case described in an abstract of the paper in Science Abstracts, February, the rays appeared of a nearly blinding intensity to the subject while they were only faintly luminous to the ordinary eyes. The results showed that the rods are more sensitive than the cones.—Dorn. *Weid. Ann.* 66, p. 1171.

Continuous Discharges.—In order to find whether the discharge through a vacuum tube was continuous Mr. Cantor made some tests with a coherer, which are described in the *Wied. Ann.* No. 2, abstracted briefly in the Lond. *Elec.*, March 31. He used a battery of 1000 accumulators; with a coherer filled with small iron screws, he distinctly found the presence of waves, showing that the discharge was not continuous. It remains now to find whether any portion of the discharge is continuous or whether there is no such thing as a continuous discharge in vacuum tubes.—Cantor. Lond. *Elec.*, March 31.

Hysteresis in Dielectrics.—Schaufelberger found that the loss of energy due to hysteresis in paraffin is 2.119 per cent. and in hard rubber 63.49 per cent., which latter is only an approximation.—*Wied. Ann.* No. 2.

REFERENCES.

Theory of Cathode Rays.—A brief discussion of Sutherland's recent paper.—J. J. Thomson. *Phil. Mag.* April.

Conduction by Röntgen Rays.—A long article on convection currents and on the fall of potential at the electrodes in conduction produced by Roentgen rays.—Zeleny. *Phys. Rev.*, March.

ELECTRO-CHEMISTRY AND BATTERIES.

Alkali Works.—An illustrated description of the Castner-Kellner works at Weston Point, by Mr. Kershaw, is published in the Lond. *Elec. Rev.*, March 31. A detailed description of this well known process is given. A short table gives the theoretical and actual yields of a number of different processes, compiled from earlier articles which have been already noticed. For the Castner-Kellner the current efficiency is given as 9.1 and the energy efficiency 52.3. Another table gives the estimated costs of one ton of 70 per cent. of caustic soda and 2.1 tons of 35 per cent. bleach for the various processes; for the Castner-Kellner it is about $49; at current prices the selling value of this amount is $77.50. At present the works are operated at a good profit. The electrolytic processes are all hampered with the heavy expenditure on account of the sums paid for patent rights and the conditions will be greatly improved when these patents have lapsed.—Kershaw. Lond. *Elec. Rev.*, March 31.

REFERENCES.

Dissociation Theory.—An article on the application of this theory to the electrolysis of aqueous solutions containing two electrolytes with a common ion. He describes researches to determine the effect produced on the stage of ionization of an electrolyte in solution by an addition of different quantities of a second electrolyte and found agreement with theory.—MacGregor. *Phys. Rev.*, March.

Gas Accumulators.—An unfavorable criticism of the recent suggestion of Nausouty (see Digest, April 1).—*L'Ind. Elec.*, March 25.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Separation of Hysteresis, Foucault Current and Friction Losses.—The conclusion of the article abstracted in the Digest April 8. The application of his method is illustrated by a number of examples illustrated with curves and tables. He shows that the friction losses are not even approximately proportional to the speed, and to illustrate this more fully he gives the results of another test made by running a motor unloaded, then suddenly cutting off the current and noticing the fall of speed during successive seconds, from which data the friction can be calculated for each speed; the curve

of these results is given and the agreement with his other results is very good. He summarizes his conclusions as follows: The Hummel method for separating the losses gives incorrect results; the method of Kapp for separating the Foucault current losses from the others, also gives incorrect results; the losses by friction are not proportional to the speed, but increase appreciably with it.—Dettmar. *Elek. Zeit.*, March 23.

An Apparatus for Photographing Curves.—The apparatus of Mr. Hotchkiss, described in the ELEC. WORLD, Sept. 26, 1896, has since been improved, and is now described in detail by him in the *Phys. Rev.*, March, accompanied by reproductions of a number of curves obtained with it. The object was to provide a portable instrument which will give continuous record of two variable currents or voltages so as to show their corresponding values at any instant. It consists essentially of two quick acting galvanometers of the Deprez type with minute moving parts separated by a quartz fibre in the strong field of a permanent magnet. There is also a revolving drum carrying a photographic film. Curves are given of the current and voltage from various alternators and different kinds of external circuits; they appear to be remarkably good. Among these are some in which the current was passed through an electrolytic cell consisting of carbon and aluminum in alum, which will allow the current to flow from the carbon to the aluminum, but offers great opposition in the other direction.—Hotchkiss. *Phys. Rev.*, March.

Alternating Current Curves.—In the Digest, March 4, an article by Mr. Seefehlner was abstracted, in which he described an application of the Braun method of showing the form of an alternating current curve on the screen by means of cathode rays. In the *Elek. Zeit.*, March 23, Dr. Zenneck states that he had used this method as early as July of last year, and has so improved it that he can obtain with it curves showing with great precision the finest details in the curvature, and he has succeeded in photographing the images formed in a fraction of a second, which is a very important improvement in the practical application of the method. He promises a further and more detailed description, the present being only a preliminary note. —Zenneck. *Elek. Zeit.*, March 23.

Measuring Light by Chemical Energy.—In a article by Berthelot in the *Comptes Rendus*, July, a brief abstract of which is given in the *Am. Jour. of Sc.*, April, he discusses the distinction between photochemical which are endothermic, in which the light energy is converted into chemical energy, and those which are exothermic in which the light is merely auxiliary, the greater portion of the change being effected by purely chemical agencies, and he concludes that the measurement of luminous energy by a transformation into chemical energy is to be effected only by the former reactions which are irreversible at ordinary temperatures.—Berthelot. *Am. Jour. of Sc.*, April.

Instrument for Measuring Illumination.—In a French Academy paper by Mr. Onimus in *Comptes Rendus* 127, p. 663, noticed briefly in *Science Abstracts*, February, he describes an apparatus for measuring the total intensity of daylight. It consists of a box whose lid has 24 holes numbered in succession. The first one is covered with a film of collodium slightly tinted with aurentia, the second with two films, and so on. Sensitive paper, preferably that made of ferroprussiate, is exposed under this row of holes and the highest number appearing on the paper is then a relative indication of the intensity.—Onimus. *Comptes Rendus* 127, p. 663.

Maximum Sensitiveness of Galvanometers.—Mr. Fery in a French Academy note reprinted in *L'Ind. Elec.*, March 25, makes some theoretical deductions concerning the ratio of the resistance of the suspension wire to that of the coil (in the form of a square), which will give the maximum sensitiveness in a movable coil galvanometer of the d'Arsonval type. He determines what these two resistances must be in order that their sum, which is the total resistance of the galvanometer, is a given amount, and he finds that the resistance of the suspension wire should be twice that of the coil. In the usual galvanometers the former is about 0.5 ohm and the latter 200, while according to his deduction the suspension wire should have 132 ohms and the coil 66, which will increase the sensitiveness 153 times. (Practically this means that the suspension wire should be long and thin. It is not stated whether he found this to be the case in practice; it would seem that a suspension wire of such a resistance would be impracticable).—Fery. *L'Ind. Elec.*, March 25.

Best Reading for Least Errors.—Mr. Baum, in the *Phys. Rev.*, March, deduces by means of the calculus, a general formula giving the conditions which will determine the best reading of an instrument for the least errors in measuring a given quantity. The formula is simple in appearance, but requires the use of the calculus. He applies it to the slide wire bridge showing that the reading should be taken near the centre of the wire. Also to the tangent galvanometer, showing that it should be at 45°.—Baum. *Phys. Rev.*, March.

Wehnelt Interrupter.—Mr. Strachan in the Lond. *Elec. Rev.*, March 31, quotes an extract from Gore's *Art of Electrometallurgy*, page 197, in which reference is made to the peculiar movements of mercury when acting as an electrode in electrolysis; a globule of mercury contracts on the passage of a current; a full account was published in the *Proc. of the Roy. Soc.*, 1862. The phenomenon usually occurs only at the negative electrode, and it seems that the solution should contain mercury. It is said that sounds were produced and the current was made imperfectly intermittent, and it was suggested that the arrangement may be of use to take the place of the break and hammer.—Strachan. Lond. *Elec. Rev.*, March 31.

REFERENCES.

Constructing an Ampere and Voltmeter.—A long illustrated description which appears to be quite complete, showing how to construct a voltmeter suitable for a small switchboard on the principle of the d'Arsonval galvanometer, and an amperemeter based on the suction of a core into a coil.—Hopkins. *Sc. Am. Sup.*, April 15.

Measuring the Properties of Permanent Magnets.—An illustrated article describing experiments made with the measurement of permanent magnets by the Guillet method, which was described in the Digest March 18. The present article contains an illustration of the apparatus.—Guillet. *L'Eclairage Elec.*, March 18.

Meters.—An illustrated description of a new motor meter made by a French company, which is claimed to be simpler and cheaper than the more accurate Brille form made by them, and largely used in France. It is of the usual form of motor meter, the damping being produced by a copper ring moved between a large number of small permanent magnets.—Aliamet. *L'Elec.*, April 1.

Meters.—Brief illustrated descriptions taken from patent specifications.—Armagnat. *L'Eclairage Elec.*, March 18 and 25.

Automatic Vacuum Pump.—A brief illustrated description of a modified Geissler pump to which a method of electrical control has been applied for controlling a three-way cock which will apply either pressure or suction to the flask.—Lawrence. *Science*, April 7.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Wireless Telegraphy.—A reprint of the reply of Marconi to the recent discussion of his paper (see Digest, April 8) is published in the Lond. *Elec.*, March 24, and abstracted briefly in the Lond. *Elec. Rev.* and *Lightning*. Among the more important remarks are the following: The use of oil in the spark gap has no advantage, but on the contrary is a disadvantage, as it seems to offer a very variable opposition to the discharge. He obtained much better and constant results between spheres that were not polished and he found the use of mercury in the coherer to be necessary to get the best results; as far as commercial work was concerned, he also found it necessary to exhaust the tube to about 1-mm. Concerning the necessity of earth connections, he states that in order to obtain the greatest possible distance with a given height, the earth connection at both the transmitter and receiver was necessary; but if suitable capacities were substituted for the earth, communication can still be maintained although the distance is somewhat shorter. A small capacity on the earth wire of a receiver was sufficient for good results, but a much larger one was required at the transmitter. The question of the function of the earth connection is discussed. When the instruments were connected to earth and then disconnected from the vertical conductor of the receiver, good signals were still received at distances of many miles, but the lower end of the vertical conductor must be nearer the receiver, and from here the oscillations jump across the gap. This seems to show that actual metallic connection was not always necessary, as with high frequencies the oscillations would bridge over the gaps. It is not necessary to have an actual metallic connection with the earth, as this will be effected through the ether; what is called a good earth is therefore not necessary, a capacity being quite sufficient. It was easier to telegraph over water or perfectly open space, than over undulating land, but the difference in the height of conductors was not as great as Gavey had claimed, 35 ft. over water and 50 over land (this explains the discrepancy in the report abstracted in the Digest April 8). He believed that over water the maximum result would always be obtained. It is unnecessary for the stations to be fixed at a height over water to obtain good results. The greatest distance which had

been reached over water was 25 miles off Kingstown. He intends to continue on a large scale, experiments with the tuning of the circuits. He thought the danger from lightning had been overestimated, as during two years of experimenting none of his wires had ever been struck by lightning. If necessary, lightning rods higher than the vertical wire could be erected without interfering with the system. He screened the receiver from the rest of the transmitting apparatus by enclosing it in an earthed metallic box. Owing to the large wave lengths, which are calculated to be about four times the length of the vertical conductor, reflectors would have to be very large to be effective. Good results have been obtained even with a battleship intervening between two stations. In one case signals were transmitted over 400 yards through nine houses and a hotel constructed largely of iron. The use of accumulators is not necessary, as good results were obtained with dry cells. In the coherer, nickel filings mixed with a small percentage of silver and mercury was the best mixture. The vertical wire may point downward as, for instance, from the top of a lighthouse of a cliff.—Marconi. Lond. *Elec.*, March 24.

A very long abstract of the original paper is reprinted in *Eng. News*, March 30.

Wireless Telegraphy.—The recent experiments of Prof. Tissot were described before the French Physical Society, a brief notice of which is published in *L'Eclairage Elec.*, March 25. He made careful investigations of the effects of various conditions. He prefers a powder of silver, in the coherer, coated slightly with the sulphide, between fixed platinum electrodes; the sensitiveness depends above all on the density of the current, and he prefers tubes 1-mm in diameter. He used the Righi exciter; it is not necessary that the "antennae" of the receiver should be vertical, as it suffices that they be normal to the direction of propagation; the capacity does not appear to be of importance, but seems to prove that there is no resonance.—Tissot. *L'Eclairage Elec.*, March 25.

REFERENCES.

Laws Concerning Telegraphic Lines.—A reprint of a set of laws for Germany which are now under consideration by the Reichstag. They refer to the telegraph and telephone line wires running through the country, the right of way, their protection, etc.—*Elek. Zeit.*, March 23.

The British Postoffice and Telephony.—The beginning of an article on this subject by Mr. Varley.—Lond. *Elec. Rev.*, March 31.

Siphon Recorder Signals.—The conclusion of the article noticed in the Digest Feb. 4.—Rymer Jones. Lond. *Elec. Rev.*, March 24.

MISCELLANEOUS.

Electrical Siren.—A siren devised by Mr. Trudeau is described and illustrated in the *Can. Elec. News*, March. It consists essentially of a diaphragm vibrated by an electromagnet like in a telephone, the currents from an alternator, the frequency of which can be varied at pleasure so as to change the note emitted. The one illustrated is intended for lighthouses, the light and the siren being switched into the circuit alternately each minute by means of a clock operating mercury contacts. It is proposed to use gasoline engines to drive the alternators, and the power required is said to be 1-hp; the cost is estimated at 15 cents per ten hours run.—Keeley. *Can. Elec. News*, March.

Electric Fish.—A paper was recently read before the Royal Institution by Prof. Gotch on the malapsterurus of the Nile, a brief notice of which appears in the Lond. *Elec.* March 24. Unlike in the gymnotus and the torpedo, the electric organ of that fish does not impede its motion; a comparison with other like fishes induced him to discard the older theories of the method by which they generate electricity; he inclines to the view that the seat of the e. m. f. is the nerve centre and not the collection of plates which were heretofore considered to be the electric organ. These plates are formed of a modified muscular substance and number about two million; they are separated by an albuminous composition which is connected by a single nerve fibre to the nerve centre. The e. m. f. of each of these "cells" (but what is meant by a cell is not explained in the abstract) was measured with a capillary electrometer and found to be about 0.04 to 0.05 volt, which is about of the same order as that generated by the contraction of a muscle. A single excitation generates an oscillatory e. m. f. It is suggested editorially that his hypothesis might be completed and rendered more probable by assuming that the collection of plates is a condenser or series of condensers charged at will by the fish, as this would account for both the time lag and the oscillatory discharge. The currents generated were demonstrated by means of a telephone and a frog-nerve.—Lond. *Elec.*, March 24.

REFERENCES.

Effect of Alternating Currents on Animals.—A long abstract of a recent Academy paper by Prevost and Battelli from *Comptes Rendus* 128, p. 668, giving a number of results of 170 experiments with various voltages from 5 to 4800.—*L'Eclairage Elec.*, March 25.

Electric Heating.—An abstract of a paper read before the French Society of Civil Engineers, giving some data, but containing apparently nothing of special importance.—Lalance. *L'Ind. Elec.*, March 25.

Biographical.—A short biographical sketch of Gustav Heinrich Wiedemann, the editor of *Wiedemann's Annalen*, who died recently. —Lond. *Elec.*, March 31.

Volta Centennial.—A brief illustrated description of the exhibition at Como, Italy. It includes what appears to be a good portrait of Volta.—*Cosmos*, Feb. 25.

New Books.

TEMPERATURE COEFFICIENT OF CONDUCTIVITY COPPER. London: Clark, Forde and Taylor.

This pamphlet contains an account of some recent measurements made on the resistivity temperature coefficient of copper wires by the authors. The result is represented approximately by the linear relation

$$R_t = R_o\ (1 + 0.004295t), \text{ or more nearly} \qquad (1)$$

$$R_t = R_o\ (1 + 0.004267t + 0.0000011941t^2) \qquad (2)$$

This relation is derived from about twenty observations taken between the temperatures t=0°C. and t=100°C. The authors compare their results with those represented by Matthiessen's formula

$$R_o = R_t\ (1 - 0.003870t + 0.0000090091t^2) \qquad (3)$$

The pamphlet ends with tables computed according to their most reliable formula, (2). The authors recommend the use of these tables as representing the actual behavior of copper wires at present in use.

DICTIONNAIRE TECHNIQUE FRANCAIS-ANGLAISE. OUTILS ET USTENSILES. By A. S. Loverdale. Paris: Boyeau et Chevillet. 156 pages. Price, 3 francs.

For those translating from technical articles this little work gives a clue to many of the idiomatic engineering expressions that could not be found in the more general dictionaries.

BOOKS RECEIVED.

Elementary Practical Physics. A Guide for the Physical Laboratory. By H. N. Chute, M. S. Boston: D. C. Heath & Co. 407 pages, 274 illus. Price, $1.25.

Inductive Elementary Physical Science. With inexpensive Apparatus and Without Laboratory Equipment. By F. H. Bailey, A. M. Boston: D. C. Heath & Co. 138 pages, 132 illus. Price, 50 cents.

Engineers' Handy-Book. For Steam Engineers and Electricians. By Stephen Roper. Philadelphia: David McKay. Fifteenth edition. Revised and greatly enlarged. 870 pages, 325 illustrations. Price $3.50.

The A B C Universal Commercial Electric Telegraphic Code. —Specially Adapted for the Use of Financiers, Merchants, Ship Owners, Brokers, Agents, etc. By W. Clauson-Thue, F. R. G. S. New York: The American Code Publishing Company. Fourth Edition. 480 pages. Price, $5.00.

A New Generator With Minimum Field Distortion.

By Robert Lundell.

The Sprague Electric Company has recently placed upon the market a line of direct-current constant potential generators ranging from 37.5 kw to 100 kw, of the direct-connected engine type, and from 75 kw to 200 kw of the belted type. Each machine has been carefully designed so as to fulfil the following requirements:

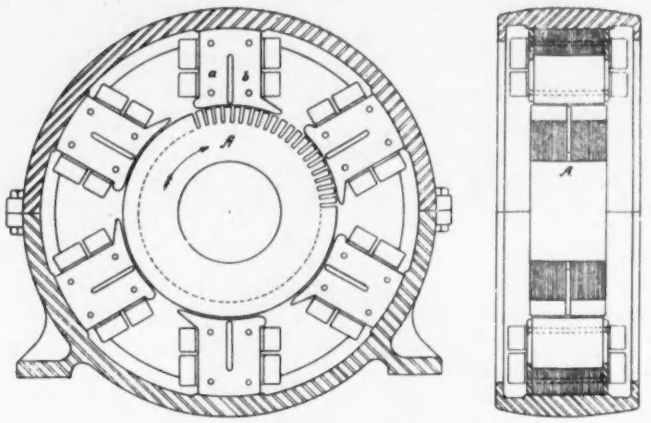
"It shall be of simplest design, smallest possible dimensions and weight per kw output. It must not heat more than 75 degrees F. above the surrounding air after a continuous ten-hour run at full load. It must be non-sparking at the brushes between no load and 50 per cent. overload, and it must not show injurious sparking at short time overloads of 100 per cent. without change of position of the brushes. (The brushes on a dynamo, after once set in the proper position, should never be disturbed, as any change of position will alter the potential as well as the percentage of compounding.) The

machine must respond quickly to changes of load, and the characteristic curve of potentials for various current outputs should approximate as nearly as possible a straight line. It must necessarily be efficient, durable and reliable in all details of construction."

In designing this dynamo particular attention has been paid to heating and sparking, the factors which limit the output of all dynamos.

The heating has been overcome by superior ventilation and by slightly decreasing the I^2R and iron losses, as will be fully understood by the detailed description.

The sparking has been overcome by eliminating as far as possible the evil effects of armature reaction or of the cross-magnetizing tendency of the armature current. The armature current has, as is well known in the art, a demagnetizing and a cross-magnetizing effect upon the field poles. The demagnetizing effect (due to



FIGS. 1 AND 2.—CROSS-SECTIONS OF MACHINE.

the armature current between the double angle of lead of the brushes) can readily be compensated for by compounding, but the cross-magnetizing or distorting effect is not so easily overcome. The cross-magnetizing force of the armature causes the magnetic flux with increasing load to diminish at the pole-corner where the commutation takes place, and to increase at the opposite pole-corner; or, in other words, it causes the magnetic flux to shift between no load and full load, necessitating a shifting of the brushes in the larger sizes of dynamos, which depend upon field strength for sparkless commutation. To overcome this difficulty many remedies are employed, some of which are exceedingly complicated and expensive. The usual method is to employ extra strong

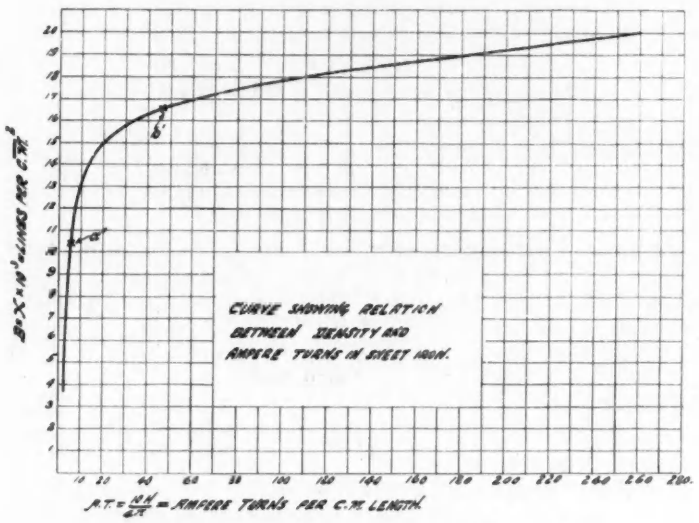


FIG. 3.—SHEET IRON MAGNETIZATION CURVE.

fields with a concentrated pole flux and comparatively large air gaps, which method only diminishes but does not cure the evil. Strong fields are expensive on account of the increased size and weight of frame and wire they involve. Large air-gaps are expensive for the same reasons, and are, furthermore, inefficient.

The method herein described not only more completely remedies this difficulty but at the same time permits of a realization of the logical advantage of a fixed point of commutation, viz., a general reduction of total weight, dimensions and cost.

For detail description, reference is made to the diagrams, in which Fig. 1 represents a side elevational cross-section of the machine and Fig. 2 a vertical cross-section taken on the centre line. Fig. 3 is a saturation curve for the sheet iron employed in the construction of the armature and the pole pieces, and Fig. 4 is a

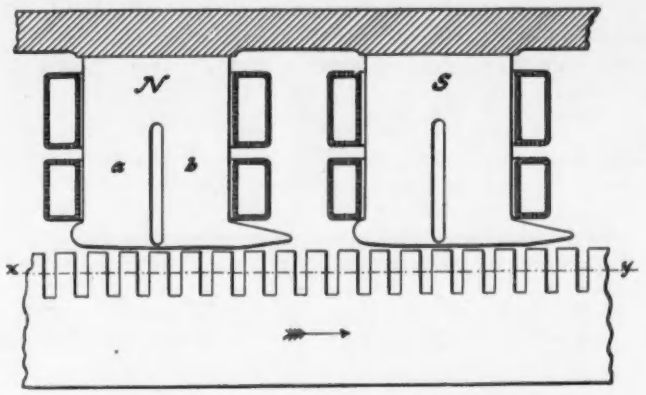


FIG. 4.—DEVELOPMENT OF 50-KW LUNDELL GENERATOR.

developed view of a pair of pole pieces, a part of the yoke and a part of the armature core in a 50-kw engine-type machine.

Fig. 5 is a diagram showing the ratio of the inductions under the pole faces at full load and at no load (in the above machine), as calculated from the magnetic reluctances and the magnetizing forces of the field and the armature currents. Fig. 6 is a diagram showing in like manner the actual mean induction across the line *X-Y* of Fig. 4 at full load and at no load, as measured by a well known voltmeter method.

Fig. 7 is a diagram showing the distribution of potential around the commutator at full load and at no load. Fig. 8 gives curves

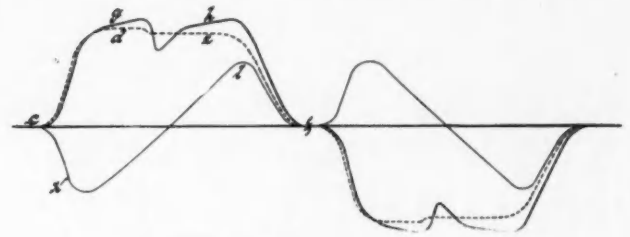


FIG. 5.—CALCULATED POLE-FACE INDUCTION.

showing the regulation and the commercial efficiency of the machine referred to.

Fig. 9 is a diagram of the mean induction across the line *X-Y* of figure 4 at full load and at no load, measured by voltmeter readings when the machine was running in wrong direction (without poles being turned around), and Fig. 10 is a diagram showing the corresponding distribution of potentials around the commutator.

Referring to Fig. 1, *A* represents are armature of the machine, which in this instance is designed to rotate from left to right. It is of the usual slotted type. The field magnet cores are divided, as shown, into two parts—*a* and *b*—of practically the same cross-sec-

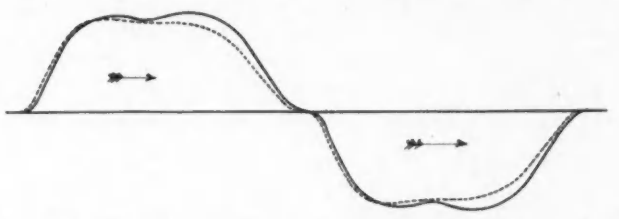


FIG. 6.—TEETH INDUCTION AT X-Y FROM VOLTMETER READINGS.

tion. The pole face of *a* is of an area only slightly larger than the cross-section of said part, whereas the pole face of *b* is of about twice the area—this increased area being due to a long wedge-shaped polar extension with which the core *b* is provided. The poles are built up from sheet iron punchings and are so designed that they may readily be turned around in case it should be desired to run the armature in the other direction.

To understand the fundamental feature of this construction, it may be well to look at Fig. 1 with a view as to what will happen if the field magnet is slowly energized from an outside current while the

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armature is standing still. With a weak magnetizing force there will be a practically uniform magnetic density under the entire pole face. But as the magnetizing force is increased we will find that the magnetic density under the pole face of *b* will soon cease to increase in the same ratio as the density under the pole face of *a*. In fact, the density under *b*, when the magnetizing force has reached a certain point, will remain almost constant as compared with the density under *a*, which still increases with the magnetizing force. This is due to the fact that the core *b* has become saturated on account of its small cross-section as compared with its large

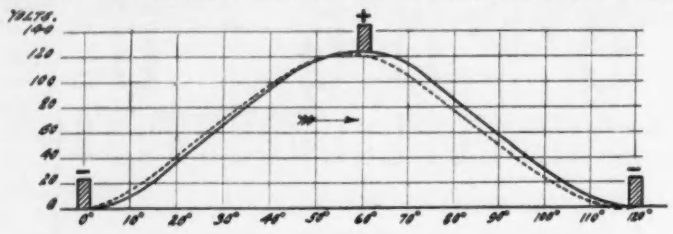


FIG. 7.—DISTRIBUTION OF POTENTIAL AROUND COMMUTATOR.

polar area, whereas the core *a* is far from saturated and is still very receptive of magnetizing force.

From the above explanation it will be apparent that if the field poles are so proportioned that the core *b*, and each part of the polar extension of *b*, is just saturated from the shunt ampere-turns alone, or when the machine is running on open circuit, the cross-magnetizing force from the armature as well as the series ampere-turns around the cores with increasing load will only have a very slight effect upon the core *b*, and will only slightly increase the magnetic density under its pole face. But the series ampere-turns will quickly change the density under the pole face of *a*, as the core *a* is not saturated and therefore sensitive to changes in the magnetizing force.

The compound winding or series ampere-turns will consequently strengthen the magnetic density under the pole face of *a*, at which point a strong field is needed to secure sparkless commutation.

The diagram, Fig. 5, will serve to illustrate the relative magnetic densities across the airgap at no load and at full load in a 50-kw machine in which the armature ampere-turns between each set of

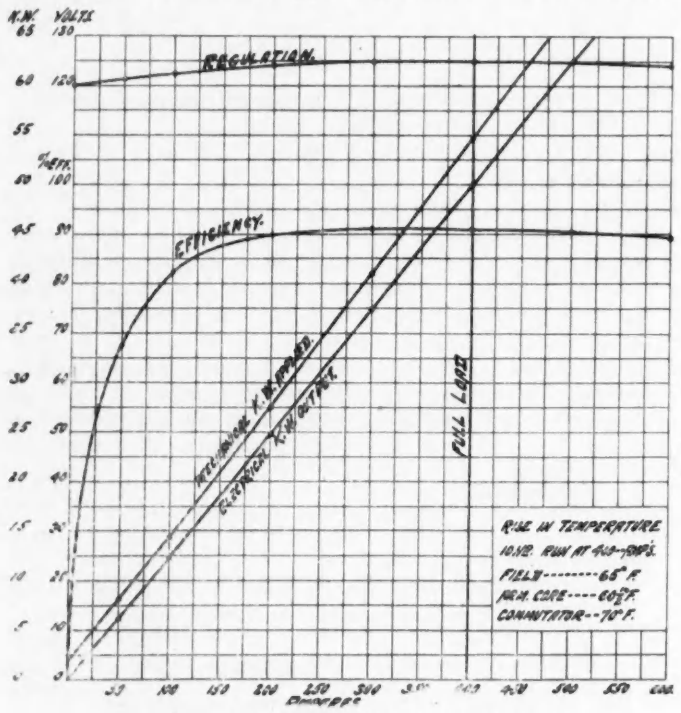


FIG. 8.—REGULATION AND EFFICIENCY CURVES.

brushes are 7500 at full load, the series ampere-turns per pole at full load 2600, the shunt ampere-turns per pole 3360 and 3382 at no load and full load respectively, and the airgap 7-64 of an inch in the centre of the pole. The line *c, d, e, f* represents the airgap induction at no load; the line *c, g, h, f* the induction at full load; and the line *c, k, l, f* the cross-magnetizing effect of the armature. The diagram, Fig. 6, illustrates the mean induction across the line *X-Y* of Fig. 4, plotted from voltmeter readings—the heavy line representing the induction at full load, and the dotted line the induction at no load.

From an inspection of this diagram it will be apparent that when this machine is working at about 75 per cent. of its rated capacity the mean induction across the line *X-Y* will then approximate (as far as uniformity is concerned) the induction at no load of any ordinary machine.

The diagram Fig. 9 is particularly interesting when compared with diagram Fig. 6, and seems to indicate a certain advantage of the slot alone in the pole pieces, even though the machine be running in the wrong direction.

The diagrams Fig. 9 and 10 show, however, a much greater distortion from no load to full load than the diagrams Figs. 6 and 7.

On account of the extremely small distorting effect from the armature cross-ampere turns when the machine is running in the right direction, it is possible to employ a much smaller airgap and to deal with greater armature reaction without danger of sparking, and to cover more circumferential area of the armature with the field poles, than is possible with the ordinary arrangement of field cores and poles. This results in a great saving in the shunt wind-

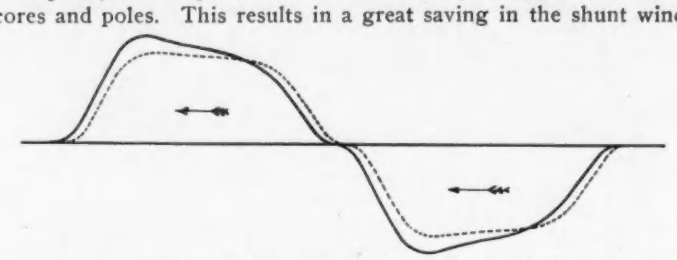


FIG. 9.—TEETH INDUCTION AT X-Y, GENERATOR RUNNING IN WRONG DIRECTION.

ing and in the dimensions of the magnetic frame, resulting also in an increase of efficiency.

On the saturation curve Fig. 3 are indicated two points, *a'* and *b'*, representing the magnetic densities in the respective cores *a* and *b* at no load. It will be seen that the core *a* is worked on the unsaturated portion, and the core *b* on the saturated portion of the curve. The armature core is also worked on the non-saturated portion and the teeth on the saturated portion (the bend or knee of the curve being entirely avoided and only the straight portions being used), from which it follows that the characteristic curve of potential for various outputs must approximate a straight line.

By reason of the fact that laminated field cores and poles of the above construction are employed, the machine becomes capable of withstanding sudden violent changes of load without sparking and without material change of potential. Particular attention has

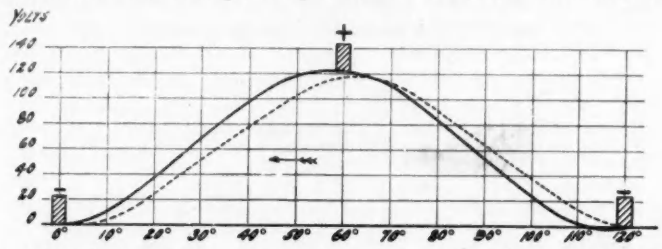


FIG. 10.—DISTRIBUTION OF POTENTIAL AROUND COMMUTATOR, GENERATOR RUNNING IN WRONG DIRECTION.

been given to securing superior ventilation of the relatively small armature and to the construction of the commutator and the brush holders. Experience has proven that a commutator with absolutely non-sparking carbon brushes has a longer life than a commutator having non-sparking copper or metal brushes; in fact, the wear of the former, if well taken care of, is insignificant. Hence, carbon brushes are employed for the machine described, and carbon holders of the simplest construction have been invented which possess the following advantages:

1. Noiselessness. 2. Maximum current-carrying capacity, insuring efficiency and non-heating. 3. Operating in either direction with equal facility. 4. Minimum weight of clamp, reducing tendency of carbons to jump. 5. Maintaining parallelism of carbons and commutator during entire life of both. 6. Utilization of entire surface of commutator bar by reason of carbons abutting against each other, thus insuring even wear over the whole surface of the commutator and preventing the development of ridges on its surface. 7. Correcting the known tendency of one of a multiple of carbons to carry more than its due ratio of current.

The following report from the late Dr. John Hopkinson was written some time before this dynamo was ready for the market:

"I have read a description of the Lundell and Johnson improved

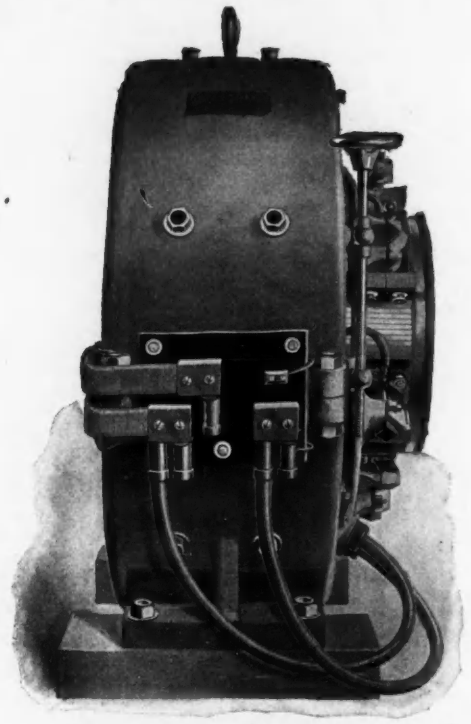
machine, prepared by Mr. Lundell. I have also examined the curves which show the electromotive forces at various parts of the field, and a drawing illustrating the proposed method of improving the machine.

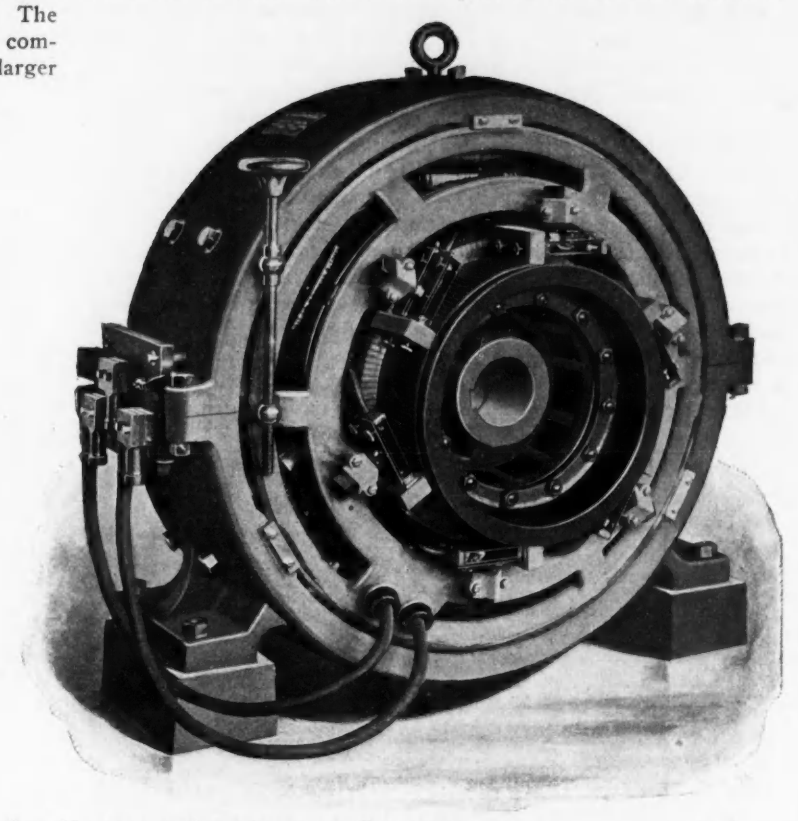
"It has long been known that in ordinary compound wound continuous current machines, and also in shunt wound continuous current machines, the current in the armature of the machine has a distorting effect upon the character of the field in which the armature coil is moved. The amount of this effect is quite calculable, the method of calculation having been, I believe, first set forth by myself. The effect of this distortion is that the proper position of the brushes for commutation is changed, and that if this change is not made, sparking which may be injurious to the machine results. Various attempts have been made to so construct machines that the position of the commutation shall not be changed owing to the distorting effect of the current in the armature. It is to attain this end that the Lundell and Johnson improvement is addressed. The improvement is perfectly simple. The magnet is to be divided into two parts of about equal section wound with the same coils of wire for exciting. One of these parts has a large polar extension so that the area of armature opposed to it is considerable. The other part has a smaller polar extension. The result is that a comparatively small current will fully magnetize the part with the larger polar extension, but will not fully magnetize the part with the smaller polar extension. On increasing the current the part with the larger polar extension has its magnetism increased to a moderate extent only, while the part with the smaller polar extension has its magnetism much more largely increased; the result being that the distortion of the field is effectively diminished, and can be so arranged that the point of commutation is not materially altered.

"I am satisfied that this device would be practically successful in avoiding the necessity of shifting the brushes, and in my judgment it is by far the simplest expedient which has yet been proposed to attain this desirable end.

"It really adds nothing to the cost of the machine, and introduces into it no complication."

A front and a side view of a 62½-kw machine are given in Figs. 11 and 12. The machine shown is built for 500 amperes at 125 volts and 280 r. p. m. The total length of the complete armature, with commutator, is 24¾ inches. The outside diameter of the yoke is 46 inches, and the weight, complete, 4280 pounds.





Figs. 11 and 12.—Front and Side View of 62½-kw Lundell Generator.

How the News Came from Manila.

The Volunteer Signal Corps has been greatly distinguishing itself at Manila; in fact, as we write a despatch appears in the newspapers under date of April 14, which says: "McKenna, of the Signal Corps, is indefatigable. He ran a wire through the hostile country without having a guard with him." We have lately come into possession of a statement from First-class Sergeant Edward E. Kelly, of the First Company, Volunteer Signal Corps, in charge of the telegraph, and in printing it may be noted that it is signed also by Corporal W. F. Schoeneman, of the First Company, a lineman of 20 years standing. The document has kindly been loaned to us by Mr. R. E. Gallagher, general manager of the New York Insulated Wire Company, who has been asked to make it a part of the government archives, bearing as it does upon the course of great events:

So many cheap and inferior materials have been sold the government during its recent war, that when one finds a good article it's worth seems magnified; and the service rendered by your "Raven Core" No. 12, B. & S. gauge, has been so grand, that it seems worthy of a greater pen than mine; to it this organization is largely indebted for its success. The First Company, United States Volunteer Signal Corps, consisting of 55 enlisted men and five officers, landed at Cavite Aug. 1, and immediately commenced to string a wire from Cavite to Camp Dewey, a distance of about 25 miles. The route lay through a tropical jungle where the foliage of the trees was so dense that it was impossible to work an uncovered wire, without the expenditure of much time and labor; by using your "Raven Core" we were enabled to establish communication between the American intrenchments, Camp Dewey and Cavite in four days.

On Aug. 13 (the day of the battle) we had telegraph lines working between each division of the advance and reserves with headquarters on the beach at the left of the intrenchments and during the engagement we kept up communication with the fleet by visional signaling and each brigade of the army by telegraph. When the order came for the advance on Manila, I was given charge of the squad which was to string the line into the Spanish intrenchments. Starting behind the skirmish line with a cart loaded with "Raven Core" and by stringing the line on the ground without using poles or insulators, we were enabled to keep up with the skirmish line and almost simultaneous with the raising of the American flag over the Spanish intrenchments, the telegraph line was flashing the news back to the reserves. At one point the wire was submerged in water for about 100 yards, but the insulation saved the day.

On Aug. 16 Lieutenant Perkins ordered me to take 500 feet of "Raven Core," which had been picked up from the battlefield, go aboard the New York *Herald* launch, and help repair the severed Hong Kong cable. We raised the cable out of the bay and put in a patch of 300 feet of "Raven Core," and the Hong Kong cable worked through it without interruption until the English cable ship arrived three weeks later and put in a permanent patch.

About two months ago trouble with the insurgents seemed so imminent that it was feared that we could not maintain a land line to Cavite. We had only six miles of ocean cable, but my confidence in the "Raven Core" was so strong that I believed by using three miles of it with the six miles of cable we could make a cable that would work. A number of our electricians who claim to know all about insulation wire, etc., laughed at the idea, but Colonel Thompson, chief signal officer, Department Pac. and the other officers in charge of this branch of the service had enough confidence to give the project a trial. We found it necessary to use three miles of "Raven Core" in the bay to complete the cable. The connections, some 35 in number were made with Chatterton's compound and Manson tape, and this unique cable has been working on an open Morse circuit with 4 cells of gravity battery for six weeks, and today its measurement is not over 200 ohms resistance, wherefore I am smoking good cigars and have a few bottles of wine left, as a result of numerous wagers on the proposition.

An Arc Light Pole of Stone.

That the arc light pole is susceptible of many variations and improvements is now an accepted fact, and a tendency to get away from hackneyed forms is already beginning to manifest itself in American cities. The examples furnished by European cities have been studied, and some of the original designs furnished by artists in this country are of no inconsiderable merit. But it may be doubted whether the style here depicted will find many copies or as a starting point develop a new school. The photograph from which our cut is made reaches us from San Juan, Puerto Rico, through the courtesy of J. G. White & Co., who are doing some heavy electrical construction work there. It would be natural to infer that the column here shown was made from concrete, but as a matter of fact it is built of native stone hewn and chiseled laboriously into shape. That slave labor should have had something to do with such a colossal standard is an obvious suspicion, but evidence on that point is lacking. This column formerly carried an arc light run

STONE ARC LIGHT POLE.

from an Edison three-wire circuit, but has no arc lamp in it at present. There are no gains or steps or rungs on it, and a ladder is the only means of reaching the lantern.

It is expected that an arc light will soon be burning again in the lantern on this column, which from its position serves almost as well as a beacon as it does a street light. The idea of stone poles is not a new one, their use having been resorted to in India at the very beginning of telegraphy, in places where wood might not last or where swollen rivers had to be safely spanned. But it would seem easier to run telegraph lines on such poles than to trim arc lights daily under such conditions of difficult accessibility, and the builder in this case must have had prophetic visions of the enclosed arc. It may be noted incidentally that Spain furnishes also another curious example of an arc light pole in the old Biscayan tree at Guizpiscoa, where the decaying trunk has been encased in iron and arc lights have been hung like fruit from the metal boughs.

Test of the Safety Third Rail System.

The completed system of the Safety Third Rail Electric Company as installed for practical working at Manhattan Beach was subjected to a practical test in the presence of about 500 people on Wednesday, April 12.

The road is very nearly one mile in length and connects Manhattan Beach and Oriental hotels. It is a single track road laid with *T* rails on a stone ballasted roadbed and was built for the double purpose of transferring the public between the two hotels and to subject the Safety Third Rail system to the severest practical tests which could be devised. The line is for the most part on a level, but it contains several slight curves and one crossing with a steam road, thereby enabling practical difficulties of this special construction to be met with, and experimented upon.

The principle of the Murphy system, so called from its inventor, Captain J. M. Murphy, is not unfamiliar to the electrical public. Ample capital has been supplied to develop it and the results of the

VIEW OF THIRD RAIL AND CAR.

test of April 12 realized all of the expectations of those interested.

The specific features of merit which are claimed for the system are as follows: A single sectional rail is used, thereby avoiding the complications and the expense of two and possibly three auxiliary rails or buttons. The car carries two contact shoes, one at each end, thus enabling the gaps between the sectional conductors to be large and minimizing the number of switches. These gaps between the sectional rails are filled in with a dead rail which simply serves to support the collecting shoe as it travels from section to section. The auxiliary wiring of the system is a minimum, a single wire passing through the automatic switch and connecting to the rail being all that is needed. The switches are not interconnected by electric wires as in some systems, thereby saving auxiliary wiring to a very great extent and rendering the expense for copper feeders and taps no greater than with the ordinary trolley system.

The switch also possesses the property of being absolutely non-arcing, for the reason that a series coil in the iron-clad solenoid which actuates the switch holds it shut until all current though its jaws has ceased. This was very prettily shown at the test. A box containing eight switches which were connected to the line were as-

sembled in a small out building adjoining the Oriental Hotel. As the car passed over the section of track controlled by these switches, the latter would operate, and though they were handling currents varying from 60 to 160 amperes, as shown by the station ammeter, there was no arc whatever at the switch jaws.

Like most electromagnet systems the Safety Third Rail system uses a storage battery on the car to pick up the switches independently of the power house current. This storage battery has been a great trouble with many systems, in some necessitating the use of at least 250 cells, and requiring to be periodically removed and charged. In the system at Manhattan Beach the cells are but ten in number and are called into use only on very brief occasions when the car is picking up its switch for the first time. They are also used to light the car lamps, which therefore can be run on the multiple system and only one lamp need be turned on at a time, the necessity of five or a multiple of five therefore being obviated. The system is so arranged that the storage battery is continuously charged at all times when the car is in motion. This is provided for by a little motor-dynamo which transforms from 500 to 20 volts. This motor dynamo also carries the lamp load when driven from the 500-volt side. When the power house current is absent, the sides of the motor-dynamo exchange functions, the low voltage side becoming a motor and driving the high voltage side as a dynamo, thus supplying 500 volts to operate the switches.

The switches themselves are of the simplest construction. They consist merely of an iron-clad solenoid mounted on a slate base, the plunger of which rises and makes the main current contact. The contact pieces are of carbon, and are reinforced with copper laminæ, the order of breaking being so arranged that the carbon points leave last. The switch contains two coils, one of fine wire operating at 500 volts and the other of coarse wire which is in series with the main contacts and with the car when the latter is drawing current from the section. When the shoe makes contact with the section, current flows from the shoe through the fine wire winding and thence to ground, raising the plunger. The action of the latter first makes contact between the feeder and the section, and next breaks the shunt circuit of the solenoid. The series circuit is now carrying current and holds the switch closed until the car has passed, when for lack of current it releases the plunger, which opens the contacts with scarcely a spark.

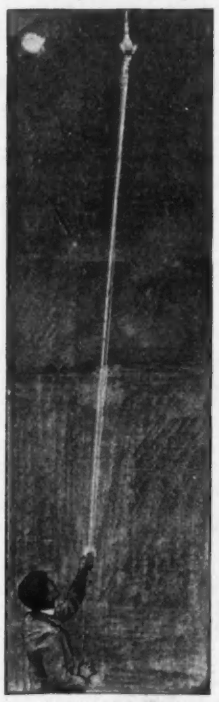
A number of interesting tests were made on the system. The car was run backward and forward heavily loaded, and started and stopped without a hitch. Having thus demonstrated that the system was thoroughly operative and practical, several interesting leakage tests were made. A section was made live by blocking up the switch controlling it, and on the track at this place were thrown water, mud, sand and other materials likely to accumulate on such a roadbed in practice. This water was slightly impregnated with salt partly due to the salt air of the locality and partly to experiments with strong salt water which had been made the day before. In spite of these severe leakage conditions, the maximum leakage obtained was .2 of an ampere, which is not sufficient to hold the switch closed and is about one-hundredth of the minimum current necessary to operate a car. When it is remembered that these results obtained were on a section in the very worst practical condition that could be devised and in practice that this leakage occurs only for an instant when the car is upon it, it shows that the problem of surface leakage, which is thought by many to be serious, is a trifling matter.

An interesting exhibit was comprised in an exceptionally large switch typical of those which are to be installed on the Baltimore & Ohio railway to handle the current for the electrical locomotives. These switches are very heavy and massive affairs, and are amply provided with laminated copper jaws to carry the unusually heavy currents. The Baltimore & Ohio electric system is probably as hard a contract as any electric traction system would ever have to meet, and if the Murphy system successfully solves the problem on the belt line, it can reasonably be inferred that it will encourage many street railway men to favorably consider its adoption.

A collation was served to the many guests who were present and congratulatory speech-making followed. The party was conveyed to and from the beach on special trains provided for them, and included many prominent financiers and railway representatives, among whom were: Cornelius Vanderbilt, T. H. Ryan, Austin Corbin, Brown Bros., E. A. Maher, N. P. Otis, H. H. Vreeland, Emerson McMillan, W. Bayard Cutting, J. N. Navarro, E. W. Bliss, C. L. Rossiter and many others. Among those well-known in electrical circles were: M. G. Starrett, L. F. Requa, F. S. Pearson, W. R. Fleming, R. H. Beach, Charles Batcheler, F. S. Drake and others. The Chinese consul general, Pac Chung Hsi, and the Japanese consul general, S. Vcheda, were interested spectators. The railways represented: Third Avenue Railway Company, Bergen County Traction Company, Union Railway Company, International & Great Northern Railway Company, Metropolitan Street Railway Company, Brooklyn Heights Railway Company, Nassau Electric Railway Company, Kings County Elevated Railway Company, New York Central Railway, Coney Island & Brooklyn Railway Company, Coney Island & Gravesend Railway Company, New York & Queens County Railway Company, North Jersey Street Railway Company, Central Railway Company, of New Jersey; Staten Island Rapid Transit Company, Staten Island Midland Railway Company, Staten Island Electric Railway Company, Lake Dunmore Power and Traction Company, Utica Street Railway Belt Line, Pennsylvania Railway Company, Willston Street Railway Company, Coxsackie, N. Y., Traction Company, Bridgeport, Conn., Traction Company, New Brunswick, N. J., Traction Company, Buffalo Railway Company, Baltimore & Ohio Railway Company, Altoona Railway Company, Washington, D. C., and Gettysburg, Pa., railways.

Incandescent Lamp Manipulator and Cleaner.

Incandescent lamps are frequently placed in high and inaccessible situations, and to clean and replace them is a task of no easy accomplishment. The consequence of such conditions is that the lamps are liable to be neglected, and dissatisfaction with the quality of light will surely follow by reason of the accumulation of dust on the lamp bulbs. To meet these conditions the incandescent lamp manipulator and cleaner, illustrated herewith, has been produced. With this device burned-out lamps can be easily replaced, and soiled and dusty bulbs can cleaned with equal facility.



LAMP CLEANER.

At the end of the long pole are two nippers or jaws which are manipulated from the lower end, by the operator. These jaws open so as to take in the lamp bulb, and as they are lined with rubber they take hold of the bulb with a firm grip and the lamp can be easily removed. The same device is used for cleaning the lamps, except that heavy cloth cleaners are slipped over the jaws. By simply revolving the pole around its axis the cloth-lined jaws slip over and around the glass bulb, thus removing any dust or other light-intercepting substances that may have accumulated on the surface.

This manipulator and cleaner is useful for street lamps, public halls, theatres, and in all places where the lamps are placed high, and will remove from 16 to 52-cp street lamps, and 16 to 32-cp indoor lamps of any standard make. The device described, which can be constructed to work at any height or angle, is manufactured by the Incandescent Electric Light Manipulator Company, 116 Bedford Street, Boston, Mass.

Formation of the Woods Motor Vehicle Co.

A great deal of interest has been shown in the news given in our pages last week as to the acquisition of the Fischer Equipment Company building the Woods motor carriages, by Mr. Samuel Insull and other leaders in the electrical field. With regard to this matter, the following despatch from Chicago has been given wide publicity: "The incorporation under the laws of New Jersey of the Woods Motor-Vehicle Company, with a capital of $10,000,000, gives to Chicago what is said to be the largest manufactory of electric carriages in the world. The new company is a reorganization and combination of several small concerns, prominent among which was the Fischer Equipment Company, which has been experimenting for a year with different methods of propulsion with most satisfactory results. Samuel Insull, president of the Chicago Edison Company;

Byron Smith, president of the Northern Trust Company, and their friends have taken all of the stock in the new concern, and none of it is for sale. The plant, which now does not come within 60 per cent. of supplying the demand, will be doubled at once. The company is now working on five horseless delivery wagons for one of the big express companies, which have been ordered as an experiment. If they come up to the expectations the express company will supplant all of its horses with automobiles within a year. The concern is also turning out two electric carriages for shipment to Paris, two for Berlin, and three for London, and has orders from Paris amounting to $98,000. The incorporators named in the papers that were filed at Trenton, N. J., are Benjamin V. Becker, George W. Mark, Frederick W. Garvin, Oscar L. Lefferts, Harry H. Picking, Duncan T. McLaren, Henry Schovenherr, Jr., Edward K. Hawkins, and C. Frederick Smith."

Upon the subject as set forth in the above, Mr. Insull remarks: "There is absolutely no truth that the Woods Motor Vehicle Company is the combination of several small concerns. It has been formed really for the development of the business heretofore run by the Fischer Equipment Company. Mr. Byron L. Smith has nothing whatever to do with the matter. It is quite true that we have a number of orders on hand, including quite a large order from Paris. The parties in interest in the concern, as noted in your columns last week, are myself, some people not in the electrical field who originally started the Fischer Equipment Company, Mr. Woods, the inventor, and Mr. Frederic Nicholls, of Toronto, with his Canadian friends, as noted by you. The outlook for us in the automobile field is extremely encouraging."

Bunnell Medical Batteries.

Note was made briefly in a "Legal" item two weeks ago that at a special term of the Supreme Court, Part II, held in and for the city and county of New York, at the County Courthouse, on March 30, 1899, Justice Francis M. Scott granted a permanent injunction in the case of J. H. Bunnell & Co. against a New York electrical supply company, restraining the latter from manufacturing or selling medical batteries similar in appearance or design to the well-known No. 4 D. D. Home Medical Battery. An accounting for damages was ordered and on March 31 judgment therefor was entered. Messrs. Bunnell & Co. say: "We originated this battery several years ago and as it was an entirely new departure, in form and otherwise, from anything hitherto produced, its introduction to the trade and medical fraternity, as well as to the public, was very expensive. Having faith in the merits of this battery, we persisted and in time were beginning to reap our reward when various concerns, seeing the demand that had been created, commenced making and selling imitations of the battery. Finally it was determined to commence suit against all infringers, and the decision just rendered in our favor means a vigorous prosecution of all offenders. Messrs. Dickerson & Brown, our attorneys, have been instructed to immediately proceed against other manufacturers and dealers who are handling imitations of our battery."

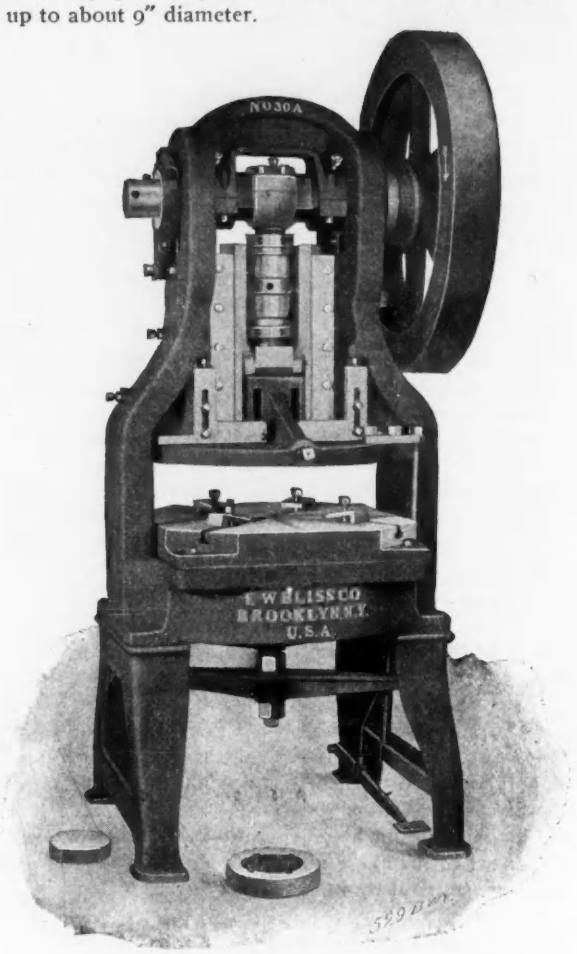
HOME MEDICAL BATTERY.

The company referred to above has received a license from Bunnell & Co., giving it the right to make and sell the battery. There is special interest attaching to this case from the fact that so far as known, it is the first on record in which the courts have sustained the rights of a manufacturer in an article that has been neither patented nor copyrighted, although it had been on the market for years and had become a standard electrical type.

Presses for the Manufacture of Armature Discs.

The requirements of armature work for electric motors and dynamos have led to the construction of presses which differ in essential points from those used for other styles of sheet metal work, and we illustrate herewith a press which has very recently been designed and built by the E. W. Bliss Company, 43 Adams Street, Brooklyn, N. Y., expressly for the manufacture of armature discs and of armature sections, though it may be adapted for other large and accurate blanking operations.

The press illustrated in the cut is especially designed for simultaneously cutting the inside and the outside of plain armature discs, with or without the key notches, such as are shown on the floor in the illustration. For this class of work, the press will take discs up to 2½" diameter, but can be made to take discs up to 24" diameter. The rings or discs, as they come from this press, are ready for notching by means of an automatic press built for this purpose by the Bliss Company. The press shown may also be used for simultaneously punching the outside notches and centre hole on discs up to about 9" diameter.



PLAIN ARMATURE PRESS.

Another type of press is built for somewhat larger work, and will take in discs up to 36" diameter. The weight of this larger press is about 25,000 pounds. The adjustment of the slide and other details will be readily understood by anyone acquainted with press construction. An improved knockout in the press bed and in the main slide does away with the heavy springs generally used to free the dies and punches of the blanks cut. With this new device, the great strain arising from the heavy spring is not put upon the frame of the press; the movement becomes a mechanical and positive one, using no unnecessary power, while that which is used is at a time when there is plenty to spare—while the press slide is returning on its upward stroke. This feature enables the user to construct somewhat cheaper and longer lived dies. This latter type of press is also largely used for cutting the sections of large generators, etc.

NEWS OF THE WEEK.

Financial Intelligence.

THE PEOPLE'S TELEPHONE COMPANY of New York has been chartered in West Virginia. The capital subscribed is $2,000,000, which may be increased to $5,000,000.

GENERAL ELECTRIC is strong in expectation of beginning regular dividends shortly. The board of directors is said to favor this, and the rate will probably be 5 or 6 per cent., payable quarterly.

CHICAGO TELEPHONE FINANCES.—An acceptance of the Illinois Telephone and Telegraph ordinance has been filed with the Chicago City Clerk. The city hall gossip is that it has already been sold out to the old Chicago Telephone Company for $150,000.

THE PENNSYLVANIA ELECTRIC VEHICLE COMPANY has four vehicles of different types now running in the city and three more vehicles, it is stated, have been shipped for use. The company has filed large orders and its stock is in very active demand. Philadelphia has a large amount of asphalted street.

NEW ENGLAND ELECTRIC VEHICLE.—It is said that the first 10 per cent. or $1,500,000 paid in upon the New England Vehicle will be devoted to the construction of 600 electric vehicles and six power stations, which practically accounts for the entire amount of cash called in to start operations in New England.

THE GENERAL ELECTRIC COMPANY'S business for the first two weeks in April is said to be the largest in its history, amounting to $2,000,000. It will be announced at the annual meeting May 9 that $4,300,000 of the $10,000,000 debenture bonds have been retired and that the accumulated dividends on preferred stock were all paid out of earnings for year ending Jan. 1, 1898.

FORECLOSURE STAYED FOR NEGOTIATION.—The request of the holders of first and second mortgage bonds of Russell Harrison's street railway at Terre Haute, Ind., and electric lighting plant, to postpone action in the foreclosure proceedings until the middle of next month, has been granted by the court. Several combinations are after the property, which occasions the delay in winding up the affairs of the company.

FIXTURE CONSOLIDATION.—Announcement was made last week of the formation of the American Gas & Electric Lighting Fixture Co., with a capitalization of $6,000,000, to consolidate the leading manufactures of electric and gas lighting appliances, including the Mitchell Vance Company and the Archer & Pancoast Company. This follows up the steps already taken in the same direction, the matter having been in hand for some time.

BROOKLYN RAPID TRANSIT.—The highest officials of the company estimate that B. R. T. will earn 5 per cent. this year on the present $41,000,000 of capital stock. They estimate the population of Brooklyn will increase 10 per cent. every year. This means to the B. R. T. system an increase of about $500,000 gross earnings every year, while the increased cost of operating the system to do this increased business will be nominal.

SALE OF NORWALK STREET RAILWAY.—It is stated that the Norwalk (Conn.) Street Railway, in which E. C. Benedict and Congressman Hill have had large interests, has been sold to a syndicate composed of W. F. Sheehan, R. A. C. Smith, H. G. Runkle, A. M. Young, and others. The reported purchasers already control the lighting interests of Norwalk. The price paid is said to have been between $65 and $80 per share, the par value of which is $25.

POPE AUTOMOBILES.—A special despatch from Boston, referring to the recent automobile deals, says: We understand that Col. Albert A. Pope has incorporated the Columbia Electric Vehicle Company, with a capital of $3,000,000, but that he is likely to become the manufacturer for the Electric Vehicle companies recently organized by the Philadelphia Storage Battery interest, instead of their competitors in the operation of electric automobiles. In fact, we hear that Mr. Pope has been offered a $3,000,000 contract for the construction of electric automobiles for the New England Electric Vehicle Company, and allied concerns.

PRICES OF COPPER.—The market for copper is exceedingly firm, with the supply of spot copper very scarce. Sales of lake are reported at 18⅝c. and a little over this price for immediate delivery. For the forward months it was claimed there were buyers last week at 18½c. as far ahead as August. Even at the higher range sellers are very independent and are declining propositions on the basis of 18½c. for any delivery. Holders are not content with present high prices, but seem desirous to screw up values to a still higher pitch, notwithstanding the enormous profits to the producer in an 18c. market, amounting in some cases to almost 12c. net gain. Business is reported good, and there is undoubtedly considerable doing in a quiet way. London cables best select £76 10s. per ton.

GENERAL ELECTRIC.—The following is from good authority: The business of the General Electric Company affords a striking example of the revival of prosperity in American manufacturing enterprises. Since the first of January the foreign business of the company has increased more than 100 per cent. over the same period last year. This branch alone will aggregate $4,000,000 for the current year. Last year the total business was at the rate of $1,500,000 per month. So far this year it is at the rate of nearly $2,000,000 per month. Among recent contracts are two for the Bristol and London Tramways amounting to over $500,000 and an order from the Metropolitan Street Railway for $300,000 of apparatus. All departments at Schenectady are working night and day, and orders are six months ahead of the capacity of the works.

STORAGE BATTERY PERSONNEL.—The expected resignation from members of the Electric Storage Battery Board and the entrance of the new interests were made at a meeting held last week. P. A. B. Widener, Wm. L. Elkins, Geo. A. Huhn and three representatives of the Whitney contingent, including Mr. Whitney's private secretary, were elected to the board. Those of the old members who remained in the board are W. W. Gibbs, George S. Philler, Isaac L. Rice, Rudolph Ellis, Joseph S. Sinnott, General Manager Lloyd and W. D. Winsor. Mr. Rice continues in the presidency for the present. The general offices of the company are to remain in Philadelphia and a new plant in addition to the one in Philadelphia will, it is rumored, be established in New York. On April 17, the company retired by cash payment its old outstanding scrip, amounting to $40,000.

THE BUYING OF MANHATTAN.—During the week Manhattan rallied sharply and got up to 127¾ on Saturday. Buying by brokers believed to be acting for Metropolitan Street Railway people and other local transportation interests was responsible for the subsequent sharp rally. In the best informed quarters it is confidently believed that the Whitney-Elkins-Widener contingent have recently become owners of large blocks of Manhattan stock. Opinion varies as to the significance of this buying—whether it is merely for speculation or for the purpose of effecting combination plans which these railway magnates have in view. Gould-Sage interests are openly bullish upon the immediate future of Manhattan Elevated stock, talking substantially higher prices for it. On Saturday Wall Street heard further talk of a probable arrangement between the company and the Brooklyn Rapid Transit system. Political factors are also credited with having been large buyers of the stock within the past few days.

KINGS COUNTY ROAD FALLS IN.—The reorganization committee of the Kings County and Fulton Elevated Railway Company of Brooklyn, of which August Belmont is chairman, has submitted a plan to the security holders which provides for the acquisition of the road by the Brooklyn Rapid Transit Company. When the deal has been completed and the receiver of the Kings County road discharged, the road will become a part of the vast Rapid Transit system. The plan provides for the deposit of all the securities of the company with the Guaranty Trust Company, the foreclosure of the first mortgages, the purchase of the property by the committee and the formation of a new company with $7,000,000 4 per cent. fifty-year-old first mortgage bonds, $2,800,000 5 per cent. non-cumulative preferred stock and $6,000,000 common stock. Only $5,000,000 of the first mortgage bonds are to be issued. The stock of the new company is then to be exchanged for stock of the Brooklyn Rapid Transit Company. The committee says that under this plan the Rapid Transit Company will get the road, subject only to a fixed charge of $200,000 a year besides taxes, and that the plan also contemplates the substitution of electricity in place of steam for operating the road.

THE WEEK IN STOCKS.—Beginning with a good deal of hesitancy and uncertainty, owing to the break of a fortnight ago, the week just past ended with many signs of recovered strength, and broadened activity, and the New York bank statement was so favorable as to lead to reasonable expectations of a bull market such as usually develops in the spring. During the week, 4785 shares of Western Union Telegraph were sold, opening at 93⅝ and closing at 94. Of General Electric, 6275 shares exchanged hands at from 115 to 117⅛, closing at 116⅞. No fewer than 263,433 shares of Manhattan were dealt in, and prices rose from 114¾ to 127¼. Metropolitan Street Railway was less active, the transactions being 31,825 shares, ranging from 244½ to 251¾. American District Telephone is quoted at 42. In miscellaneous and outside securities, Electric Boat, common, was quoted at 35 to 37, and preferred at 49 to 53. Electric Vehicle, common, was quoted at 135 to 140, and preferred at 130 to 140. Otis Elevator, common, was quoted at 34½ bid, and preferred at 88½ to 89½. Hudson River Telephone stood at 95 to 100. In Boston, American Bell Telephone rose from 355 to 360 on small sales, and West End Railroad was a shade lower at 93½. In Philadelphia, Electric Storage Battery, preferred, was up from 179 to 190 for the week, and common, from 182 to 190. Union Traction Company advanced to 43⅞, and Pennsylvania Manufacturing Company was steady at 31⅛.

GENERAL INCREASE IN BUSINESS.—In discussing the trade situation, R. G. Dun & Co. say: "There is still increase in all legitimate business, and the productive power of great industries increases even though some of their stocks decline. The truth is that no such expansion in the general business of the country has ever been seen before, and if such records only were considered there would be ground for fear that a wild passion of trading had again lifted the whole business community off its feet. But instead there is found surprising increase in the chief industries. Naming first some of which only returns of raw materials imported give definite indications, raw silk imports increased 87 per cent. for eight months of the fiscal year over last, hides 40 per cent., india rubber 26, tin 21, and fibres 19." In its weekly report, Bradstreet's says: "Real spring weather has improved the tone of general trade, particularly at retail, and correspondingly helped jobbing distribution, but at the same time, brought last winter's injury to the winter wheat crop more in evidence. The regular monthly government crop report proved rather more favorable than expected, foreshadowing, on the basis of last fall's largely increased acreage, a yield little below that of last season. The unanimity of later damage reports would seem to point to full information regarding the crop not being obtainable at the date when the Government advices were gathered. The indifference with which the government report was received has apparently been shaded into the belief that damage has been done, and wheat prices for the first time this season may be said this week to have actually reflected crop damage reports."

Special Correspondence.

NEW YORK NOTES.

MR. W. T. BLAINE, of the Victor Telephone Company, was seen in New York again last week, and was interrogated as to his progress with the proposed independent telephone manufacturers' consolidation. He had little that was new to communicate except that things were in good shape and moving along nicely.

MR. FRANK J. SPRAGUE, is expected to read a paper before the American Institute of Electrical Engineers at the headquarters of the A. S. M. E. on April 26, on the subject of multiple unit railway work and its various features. Mr. Sprague's ability as a lecturer and his commanding position in the field of electrical invention and engineering ensure a meeting of unusual interest and importance.

NEW OFFICERS for the NASSAU ELECTRIC RAILWAY.—The new directors of the Nassau Electric Railway Company in Brooklyn Borough a few days ago elected the following named gentlemen as officers: Clinton L. Rossiter, president; Hugh J. Grant, vice-president, and T. S. Williams, secretary and treasurer. The management of the Nassau road is now identical with that of the Brooklyn Rapid Transit Company.

SOUTHERN NOTES.

THE CAPITOL TRACTION COMPANY, Washington, D. C., purchased on April 10 from the General Electric Company twenty street car equipments, motor type, G. E. 1000.

AN INJUNCTION has been granted the Richmond & Petersburg Electric Railway Company against the Richmond, Petersburg & Carolina Railway Company preventing the latter from crossing the roadbed of the electric at Drewry's Bluff, a point at which the electric company is contemplating building a large park.

ELECTRICAL CONTRACTS AWARDED.—The following contracts for the extension of the electric plant at the Norfolk navy yard have been let: Wiring, Smith-Courtney Company, of Richmond, $14,996.47; boilers, Aultman-Taylor Company, of Mansfield, Ohio, $6989; engines, etc., Crocker-Wheeler Company, of Ampere, N. J., $15,792.

ELECTRIC RAILWAY SCHEDULES IN RICHMOND.—A franchise is pending before the city council to compel all street railway companies to maintain a five-minutes schedule on their main lines. The companies contend that this is more than the business warrants, and that they will lose money by it. They threaten to contest the council's powers to enforce such a measure.

THE JAMES RIVER WATER POWER.—The Virginia Electrical Railway & Development Company, which is engaged in developing the water power of the James River at Richmond, has made a contract with the Babcock & Wilcox Company, of New York, to furnish it with four 500-hp water tube boilers. These are to be a part of the auxiliary steam plant of the water power company.

THE VIRGINIA TRACTION COMPANY, Petersburg, Va., the consolidation of the street railways and lighting companies, at present in the hands of a syndicate headed by John L. Williams & Sons, of Richmond, Va., has about completed its plans of operation. It has purchased 15 street car equipments, Type G. E. 58, from the General Electric Company, to replace some of the older type of equipment.

THE WASHINGTON AUTOMOBILE COMPANY, which was recently incorporated in this city, proposes, it is stated, in addition to supplying cabs and carriages for regular service, to secure an equipment of large carriages and vehicles capable of carrying fifteen to twenty persons. These vehicles are to be run on regular routes over the streets of the city in the same fashion as is now general with the herdics. It is thought that this new service will be inaugurated during the summer.

ELECTRICAL CONDUITS IN RICHMOND.—A syndicate headed by E. J. Willis, H. E. Baskerville and Philip P. Shields, of Richmond, Va., has applied for a franchise from the city council to build a conduit system throughout the main thoroughfares of the city. At present the question is under consideration. A franchise has already been passed by the council compelling all companies to place their wires under ground. It remains to be decided whether the city, the several electric companies, or a conduit company install the system.

WESTERN NEW YORK NOTES.

ELECTRIC LIGHT FOR AN ARMORY.—The Board of Supervisors of Erie County has awarded the contract for an electric light plant at the new Seventy-fourth Regiment armory to McCarthy Bros. & Ford at their bid of $11,995.

THE NIAGARA FALLS POWER COMPANY has awarded the contract for the construction of a cable conduit from the power station to the new plant of the Union Carbide Company to Thomas Dark & Sons, of Buffalo. Sewer and drains will also be built.

THE NIAGARA FALLS HYDRAULIC POWER & MANUFACTURING COMPANY has ordered three new turbines from Messrs. R. D. Wood & Company, of Philadelphia. Each of these machines will be similar to the one last installed in the power house extension at the water's edge in the gorge, and will have a capacity of 2500-hp. They will be installed during the present year.

THE ALLOY SMELTING COMPANY is the name of a new manufacturing concern that has located on the lands of the Niagara Falls Hydraulic Power & Manufacturing Company, at Niagara Falls, where a small one-story building has been erected. In the lower power station a 250-kw, 25-volt generator is being installed to supply it with current.

A NOVEL METHOD OF DEVELOPING WATER POWER.—The Mather bridge bill has progressed to the order of final passage in the state senate. This bill grants authority for the construction of an experimental span of a bridge across the Niagara River from Massachusetts Street in Buffalo, from which shall be hung water wheels for the development of power. The bill passed the legislature last year, but the governor did not sign it.

CONDUITS IN GENEVA.—The Common Council of Geneva has approved the amendment to the city charter, giving the Board of Works power to construct underground conduits for carrying telegraph, telephone and electric light or power wires, and to compel the companies owning such wires to place their wires therein; also to bear their proportion of the cost of construction of the conduits as the Board of Public Works shall determine.

TELEPHONE FRANCHISE IN ROCHESTER.—The Common Council of Rochester has awarded a franchise to the Home Telephone Company. A flat rate of $48 a year is to be charged for all telephones, business and residence alike. In addition to this the company agree to furnish the city 40 free instruments. This is equivalent to $4000 a year. Under the provisions of the franchise work on the system must be actually commenced within one month and prosecuted diligently; the company must have and exhibit to the Mayor within two months bona fide subscriptions for at least 1500 telephones in the city on five years' contracts; such telephone system must be in actual operation with at least 2000 telephones within 15 months from the granting of the franchise. A fight between the Home Company and the Bell Company will likely ensue. The telephone wires are to be placed in conduits.

INDIANA NOTES.

ELECTRIC LIGHT STOCK SOLD.—Messrs. S. F. Porter and J. O. Cole have sold their holdings in the Peru (Ind.) Electric Light Company, amounting to 555 shares of paid-up stock, to C. H. Brownell and the Citizens' National Bank of Peru. Some valuable land near the city figures in the exchange. The value of the stock at par is $27,730. A new president will succeed Mr. Cole, who has served in that capacity for several years.

AN ELECTRIC RAILWAY.—The Union County commissioners have granted a franchise to a number of capitalists from Richmond and Liberty for an electric railway to connect the cities above named. At Harrison, Ohio, a connection will be made with a line leading into Cincinnati. The company agrees to begin construction within the present year and complete it within two years. Much enthusiasm prevails over the project, as it will give Brookville and numerous other towns a direct line to Cincinnati.

CO-OPERATIVE TELEPHONE COMPANY.—A warm contest has just ended in the affairs of the Rushville (Ind.) Co-operative Telephone Company. A year ago by a combine formed against Author Irvin, secretary and manager, that gentleman was ousted. He has now been reinstated by the directory. Mr. Irvin is cashier of the Farmers' Bank and an authority in telephone matters. The local company has a large number of telephones in use with a good earning capacity per month. Some telephones, however, go as cheap as 80 cents per month.

A THIRD FRANCHISE REFUSED.—A franchise has been refused Robert Smith et al, of Terre Haute, for an electric railway in the National road from Brazil to Terre Haute. Four years ago Mr. Smith asked for and secured a franchise and right of way for a line through Clay and Vigo counties to connect the two cities, but he neglected to interest sufficient capital to undertake the enterprise. A year ago he was granted a second franchise, but likewise he suffered the limitation to run against it. He now claims to have ample capital to carry out the project, but the commissioners of Clay County refused the franchise. It is said the citizens of Brazil and Clay County oppose the line on the ground that it will secure the trade of the county for Terre Haute merchants.

A FIFTY YEARS' FRANCHISE.—The county commissioners at Indianapolis, on April 14, granted to P. H. Fitzgerald, F. J. Scholz, Jessie Farkington and J. T. Elliott a franchise and right of way from the city limits to the West County line for an interurban electric line, to be built by the petitioners and others from Indianapolis to Martinsville by way of Bethany Park campground. The promoters agree to pay to the county treasurer $25 a mile for each mile of their right of way in Marion County for the purpose of keeping up repairs to the pike, along which the road is to be built. The company will build and maintain its own bridges, not approach nearer than 12 feet of the middle of the pike; begin at once the construction and equipment of the road and complete it within a year. The farmers along the proposed route petitioned for its construction and came before the commissioners asking that the franchise be granted. The line passes through a number of brisk little towns. The company will be known as the Indianapolis and Martinsville Rapid Transit Company. This is the fourth franchise the county commissioners have granted recently and other petitions are on file waiting consideration.

CHICAGO NOTES.

THE CHICAGO TELEPHONE COMPANY has leased for 99 years, at a rental of $6000 a year, from May 1, the ground adjoining its building in this city. It will make an extension to its present quarters.

THE NATIONAL BOARD OF FIRE UNDERWRITERS.—The Chicago offices and laboratory of the electrical bureau of the National Board of Fire Underwriters have been removed to 67 East Twenty-first Street, Chicago. The old quarters were at 157 La Salle Street. Mr. W. H. Merrill, Jr., is the electrician of this bureau.

THE COOK TELEPHONE PROTECTOR.—Early this year the Patent Office rendered a decision in favor of Mr. Frank B. Cook, vice-president of the Sterling Electric Company, in an interference suit against the Western Electric Company. The Western Electric Company appealed the case and a decision has just been rendered sustaining the former decision in favor of the plaintiff.

CHICAGO'S CITY LIGHTING SYSTEM.—The annual report of City Electrician Ellicott shows a decrease in the cost of operation. A new electric-light station was completed at Rice and Lincoln Streets, from which 500 lamps were placed in service. Additions were made to the lights at the stations at Halsted Street and Blue Island Avenue, and Fourteenth Street and Indiana Avenue. There were 2363 lamps at the end of last year, as compared to 1438 in 1897, an increase of 825 lamps. The amount appropriated for the installation of 840 arc lamps by the various stations was $150,000, and the department expended of that amount $140,152. For line equipments the total expenditure was $95,136.02. It cost $99,834 to operate the plant during the year, the cost per lamp being $68.52. In the fire-alarm telegraph bureau the cost of maintenance last year was $1272, as compared to the former expenditure of $3564.

St. Louis Notes.

CLOSING UP THE CABLE DEAL.—A deed from the third mortgage bondholders was placed on record last week, conveying all the property of the People's Railway Company to August Behner, L. M. Rumsey and Charles Parsons as trustees, for $500,000, the price for which the road was bought in by the reorganization committee at the foreclosure sale. All the papers in the sale of the People's line to Brown Brothers & Co., were recorded the day afterward, thus formally completing the deal.

EDISON THREE-WIRE PATENT SUIT.—The suit of the Edison Electric Light Company of New York and the Missouri-Edison Company of St. Louis, against the Imperial Electric Light & Power Company, of St. Louis, has been begun in the United States Circuit Court. The suit is on an alleged infringement of the Edison three-wire patent, and the plaintiffs ask for a temporary injunction and for damages. The defendants claim that the patent is invalid and that it has not been infringed.

THE STREET RAILWAY CONSOLIDATION IN ST. LOUIS.—The Southern Electric and Hamilton syndicate lines and the Suburban system have practically been rejected, it is said, as portions of the street railway consolidation. These lines were found by the purchases of the other lines to be inimical to their scheme for a great contiguous system. In other words, it has been discovered, since the acquisition of the People's line, that the three systems above named are not needed. It is also reported that the prices placed on the Suburban, Southern Electric and Hamilton syndicate lines must drop to a much lower figure, if they were to be even considered.

Texas and Mexico Notes.

NEW MEXICAN ELECTRIC LIGHT PLANT.—A new electric light plant has just been installed in the town of Patzcuaro, Mexico.

THE ELECTRIC FREIGHT RAILROAD in San Antonio, Texas, is in successful operation. It is the only electric freight line in Texas. Its tariffs are fixed by the Texas Railroad Commission.

DEMAND FOR MULE CARS IN MEXICO.—There is considerable demand in Mexico for second-hand mule cars. A number of electric street railway companies in the United States have sold their discarded mule cars to street railway companies in that country.

ELECTRICAL MACHINERY FOR MEXICAN SILVER MINES.—A large shipment of electrical machinery has arrived at Jiminez, Mexico, and will be transported overland to Guanacevi, state of Chihuahua, where it will be installed in silver mines. It was shipped from Chicago.

RAILWAY CONSOLIDATION IN FT. WORTH.—The two largest street railway systems of Fort Worth, Texas, have been consolidated. The stock of the company is owned principally by Fort Worth capitalists. Maj. W. P. Quigg has been appointed superintendent of the consolidated system.

AUSTIN'S MUNICIPAL LIGHTING PLANT IN DISFAVOR.—The patronage of the city electric plant of Austin, Texas, is rapidly decreasing. Superintendent Patterson's report for the month of March shows a decrease of eighty incandescent lamps for that month. The receipts for March were $6827.42.

TRAIN LIGHTING IN TEXAS.—All of the passenger trains on the Texas Midland Railroad are lighted throughout by electricity. This road is the property of Mrs. Hettie Green, of New York, and her son, E. H. R. Green, is president of the company. It is the only road in Texas using electricity for lighting its passenger coaches.

ELECTRIC PLANT FOR ACAPULCO.—Mr. J. L. Hildreth, an electrical engineer of Minneapolis, Minn., is now in Mexico, where he has obtained a concession for the construction of an electric light and power plant in the city of Acapulco. Mr. Hildreth is understood to represent Minneapolis and Chicago capitalists, who propose to invest several hundred thousand dollars in that and other enterprises in Acapulco.

INSPECTING THE TEXAS TELEPHONE SYSTEM.—President Charles J. Glidden and other officials of the Southwestern Telegraph & Telephone Company have been making an extended tour of inspection of the company's Texas system. An independent telephone company is beginning to get a foothold in that state. This new company recently established an exchange at Waco, and has important extensions in view.

STREET RAILWAY FOR CORSICANA.—Mr. W. G. Baker, of Corsicana, Texas, has applied to the City Council of that city for a franchise to build a street railway system there. Mr. Baker states that Mr. E. N. Cullom, of Birmingham, Ala., is back of the proposed enterprise. Mr. Cullom is president of the Alabama Trust and Savings Company. Corsicana is in the center of the new Texas oil field and is having a rapid business growth.

Pacific Coast Notes.

AN ELECTRIC LIGHT AND WATERWORKS plant is being installed in Prineville, Ore., by H. V. Gates. The machinery was shipped via The Dalles, Ore.

ELECTRIC LIGHT STATION BURNED.—The electric lighting station in Union, Ore., was recently destroyed by fire. A new plant will be in operation within one month.

ENLARGING THE FOLSOM POWER HOUSE.—The Sacramento (Cal.) Electric, Gas & Railway Company will install an additional unit of 1000-hp capacity at its Folsom power house, where 4000-hp is now being developed and transmitted.

AUXILIARY ELECTRIC POWER PLANT.—An auxiliary electric power plant will be installed at the pumping and hoisting works of the Allison Ranch mine, near Grass Valley, Cal. John W. Mackay, who is interested in the property, recently paid it a visit of inspection.

POWER AND LIGHTING PLANT FOR A MINE.—The Pacific Coast Company is reported to have arranged with W. J. Grambs, Seattle, Wash., representative of the General Electric Company, for an electric power and lighting plant of sufficient capacity to operate the new coal mines at Coal Creek near Newcastle, Wash. An electric locomotive of large capacity is included in the proposed equipment. The output will be 1000 tons per day.

SAN FRANCISCO ELECTRIC RAILWAYS IN COMPETITION.—In San Francisco, the Market Street Railway Company and the San Mateo Electric Railway Company are competing for the passenger traffic to Glen Park in the Mission District. The San Mateo Company's double-track line to the park is nearly completed. The Market Street Company is constructing a tunnel under the Southern Pacific tracks to connect its Mission Street line with the park.

THE SUNSET ELECTRIC RAILWAY COMPANY will soon commence work between Galena and Index, Wash. It will be a standard gauge road, and Great Northern cars will be taken to and from the various mines by electric power. The power will be developed at Sunset Falls on the Skykomish River, the capacity being 5000-hp. Work has been quietly progressing for some months past on the headworks at the power house. L. G. Habrook is president and general manager of the company; Joseph Parkins, of Everett, Wash., is secretary, and C. N. Bush, treasurer. A tunnel has been driven 160 feet through solid rock at the falls.

Canadian Notes.

ELECTRIC RAILWAY IN NOVA SCOTIA.—A project is on foot to build an electric railway between Trenton and Westville, Pictou County, in the province of Nova Scotia, to run through the towns of Stellarton and New Glasgow.

DOUBTFUL VOTE ON MUNICIPAL LIGHTING.—The property holders of the city of Winnipeg, Manitoba, voted a few days ago on a by-law to raise $60,000 for the establishment of a civic lighting plant. The vote polled was 876 for and 231 against. It is claimed, however, that a number of those voting were non-residents, and that the necessary majority to carry the by-law has not been received.

ELECTRIC FRANCHISES IN OTTAWA.—A sensation has been caused in the city of Ottawa, Ont., by the publication of fac-similes of letters offering the new Metropolitan electric franchise for sale to the Ottawa Electric Company. The Metropolitan Company applied for a ten-year charter in Ottawa last summer, guaranteeing not to amalgamate with any other company or sell out, and to have electricity in the streets within six months. The charter was granted after a hot fight in the city council. Last month the Metropolitan company came back for a thirty-year charter, the granting of which is now meeting with strong opposition.

General News.

Telephone Notes.

BLACK RIVER, OHIO.—The Black River Telephone Company has increased its stock from $10,000 to $50,000.

KANKAKEE, ILL.—The Hamlin Telephone Company has certified to an increase in capital stock from $15,000 to $20,000.

HAZELTON, PA.—The Bell Telephone Company is negotiating for a plot of ground on which to erect an office building.

AMERICUS, GA., is agitating for another telephone system. The present one, it is said, does not give entire satisfaction.

KNOXVILLE, IA.—The Knoxville Electric Company intends extending its telephone lines from Swan to Pella and Oskaloosa.

LINEVILLE, IA.—The Lineville Telephone Company contemplates extending its wires to connect with the Clinton and Warren line.

MORROW, OHIO.—Miletus Garner, secretary of the Wilmington Telephone Company, has obtained a franchise from the Council of Morrow.

McKEESPORT, PA.—The McKeesport Local Telephone Company has ordered a new 100 drop switchboard and one hundred telephones.

LAFAYETTE, IND.—The City Council has restored to the Central Union Telephone Company the franchise of which it was deprived some years ago.

PENTWATER, MICH.—The Oceana Belt Telephone Company has reduced the rent of telephones to $15 per annum for business houses and $12 for residences.

ALLIANCE, OHIO.—The Eastern Ohio Telephone Company has purchased the telephone line between Kensington and Hanoverton and put it in operation.

APPLETON, WIS.—Efforts are being made to secure co-operation in a project to form a three-city telephone company in Appleton, Neenah and Menasha.

DECATUR, ILL.—Messrs. H. M. Whitmer, C. S. Hankins and W. P. Shade have organized the Macon County Telephone Company, with a capital stock of $20,000.

DAWSON, NEB.—The village board of Dawson has passed an ordinance granting the telephone company of Falls City a franchise to put in an exchange at Dawson.

STUYVESANT FALLS, N. Y.—The Stuyvesant Telephone Company's central office is Stuyvesant Falls. The line is to be extended from the Stockport Dock to Valatie.

SHELBY, OHIO.—The Central Union Telephone Company announces that it will connect all farmers along its line through the country and make a charge of five cents per message.

McKINNEY, TEXAS.—The Blue Ridge & East Texas Telephone Company has reached this city with its line, which runs from Leonard, in Fannin County, passing through various intermediate towns.

PEORIA, ILL.—It is reported that the Citizen's Telephone Company, which was the successor to the Fulton County Telephone Company, has been absorbed by the Central Union Telephone Company.

TAUNTON, MASS.—The Taunton Telephone Company has been chartered with a capital stock of $50,000, by Messrs. Peter H. Corr, president; H. H. Shumway, secretary, and Clinton Sproat, treasurer.

GRAND FORKS, N. D.—The Northwestern Telephone Company is considering the erection of numerous suburban circuits running from the local exchange into the country for the benefit of the farmers.

ANDERSON, IND.—The Anderson (Ind.) Telephone Company has been incorporated with a capital of $50,000. The incorporators are George W. Beers, of Fort Wayne; J. Neibewelle and R. H. Gadifal, of Anderson.

BANGOR, ME.—The New England Telephone Company is extending its lines between Canaan Village and Skowhegan. The people along the route furnish the company with cedar poles, and distribute them, gratis.

BIG STONE GAP, VA.—The Virginia Telephone Company has been organized in this place, with a capital of $5,000. The incorporators are C. C. Cochran, R. T. Irvine, J. F. Fullitt and R. P. Barron, all of Big Stone Gap.

OWINGSVILLE, KY.—A company has been formed in this place to build and operate a telephone line from here to Sherburne, Fleming County. When this line is completed Owingsville will be in direct communication with Louisville and Cincinnati.

MILLVILLE, N. J.—A telephone company has been organized here under the name of the Millville Telephone Company with a capital stock of $7500. The incorporators are William H. Ott, Ephraim P. Clark, Lillie P. Ott, Pleasant R. Clark, all of Vineland.

WATERBURY, CONN.—The Waterbury Telephone Company has been organized with a capital stock of $25,000. The incorporators are F. A. Stratton, New York; W. G. Bushnell, New Haven; H. R. Durant, Waterbury, and A. J. Purinton, Waterbury.

COLUMBUS, O.—The Home Telephone Company, of Dayton, has been incorporated by H. C Kiefaber, W. P. Sunderland, Samuel R. Harshman, F. G. Mithoft and Albert Emanuel, to operate a telephone system in Dayton and Montgomery County on $100,000 capital.

DENVER, COL.—The Rocky Mountain Bell Telephone Company is making extensive improvements. It is erecting a $10,000 building in Boise, and will soon begin a line from Weiser, Idaho, to the Seven Devils and Buffalo Hump. It will also erect office buildings in Great Falls and Missoula, Mont.

BALTIMORE, MD.—The Union Telephone Company held its annual meeting on March 28 and elected M. B. Nichols, Wilson M. Tyler, Dr. J. E. M. Bateman, B. F. Parlett, A. G. Pascault and William Reddie as directors. The office of superintendent was created and Winthrop Blakeslee was appointed.

AURORA, IND.—The Bell Telephone Company will extend its line from this place to Vevay, where it will connect with the lines to Madison and Louisville. Long distance stations will be established at Patriot and Florence, and all Ohio River towns between Cincinnati and Louisville will be interconnected.

RICHMOND, IND.—The Home Telephone Company, of this city, has let the contract for the construction of its plant to the Central Construction Company, of Wauseon, O. That company is to put the plant up complete in every detail, from setting the poles to wiring the houses. The work is to be finished by July 1.

LITTLE VALLEY, N. Y.—The Castile & Silver Springs Telephone Association is about to be incorporated and will extend its lines to Perry, Gainesville and Warsaw. Arrangements have been made with the Business Telephone Company whereby connection will be obtained with fifteen different villages in this section.

KIRKWOOD, MO.—The Town Board at a recent meeting passed several ordinances, among them one requiring telegraph, telephone and electric light companies not already taxed on the gross income for town purposes to pay 50c. for each pole per annum for the privilege of using the streets, alleys and other public thoroughfares.

NEW HAVEN, CONN.—Attorney S. Harrison Wagner says that the affairs of the New York & Boston Telephone Company, which has applied for a charter to enable it to do business in this state, are progressing favorably, and he is of the opinion that before next fall the new company will be doing business in every city and town in the state.

CHAMBERSBURG, PA.—A telephone rate war has begun here between the new Homestead Telephone Company and the Bell Company, the latter reducing rates in Homestead with service to McKeesport and other valley towns, to $12 per annum. The new company has signed 200 five-year contracts for $18, with a service to Homestead only.

SYRACUSE, N. Y.—The telephone service between Chittenango, Chittenango Station, Bridgeport, Lakeport, Sullivan and Perryville, managed by J. E. Scoville, of Sullivan, has been discontinued. The difficulty arises over a misunderstanding between Mr. Scoville and the Central New York Telephone & Telegraph Company, which owns the instruments.

ROCHESTER, N. Y.—At a recent meeting of the committee on lamps and electricity the following resolution prepared by Mayor Warner was passed unanimously: "Resolved, That the competition in telephone service within the city of Rochester is for the best interest of the city, and that the committee recommended that competition therein be encouraged."

SACRAMENTO, CAL.—The Capital Telephone Company held its annual election and elected the following: Frederick Cox, president; M. J. Dillman, vice-president and general manager; W. E. Gerber, treasurer; M. R. Beard, secretary. Directors—A. Heilbron, Frank Ruhstaller, Sr., Herman H. Grau, Geo. B. Katzenstein, Geo. W. Locke and A. A. Van Voorhies.

HAVANA, CUBA.—The overland military telegraph line to Santiago was completed on April 3. There are now in operation nine military telegraph lines, crossing the island from north to south, and one trunk line running through the centre of the island from Pinar del Rio through Havana and Santiago to Baracoa. Gen. Brooke can now reach every important town and every military command in Cuba by telegraph or telephone.

DES MOINES, IA.—There is a plan on foot here backed by the Central Telephone Company to consolidate all the independent toll lines in the State. The plan of the Central Company, which was organized with a capital of $50,000, and which now controls some of the best lines in central Iowa, is to amend its articles of incorporation so as to increase its stock as fast as the smaller lines are merged with it and to exchange their stock for that of the smaller concerns.

ALBANY, N. Y.—The Mohawk Telegraph & Telephone Company has been incorporated with a capital stock of $21,000, to operate a telephone and telegraph system from Syracuse to Albany by way of intermediate towns. It will extend its lines to northern New York; east through the New England States to the Atlantic seaboard and south into New Jersey and Pennsylvania. The directors are Russell R. Stuart, Daniel O'Brien and John Holihan, of Syracuse; William Mason, of Binghamton; Harvey J. Donaldson, of Ballston, and James J. Dwyer, of Utica.

NEW YORK N. Y.—A schedule of the reduced telephone rates in Westchester County went into effect on April 1. The toll between all points in Westchester County and also to Wakefield and Williamsbridge, in the Borough of the Bronx, and Glenville, Conn., will be 20 cents instead of 25, and 30 cents as formerly. Greenwich and Coscob are to be 25 cents instead of 35 The rate to New York is still kept at 35 cents. The change has been brought about, it is said, through the competition of the local telephone companies, which now have franchises in New Rochelle, Mount Vernon, Mamaroneck and White Plains. These lines as yet have no connection with New York.

CHILLICOTHE, OHIO.—The telephone war here between the Bell Company and the Home Telephone Company has come to a head recently. The Bell Company succeeded in buying the Clarksburg & Chillicothe line, one of the connections of the Home Company, for $1500, and the Columbia Telephone Company of Waverly, for $6000. The Home Company will at once proceed to put in another independent plant at Waverly and will build a line parallel to the Clarksburg line as soon as the material needed can be secured. The acquisition of the Waverly company gives the Bell people access to Waverly and also a right of way down the Scioto valley to Portsmouth. The line will be erected at once.

ELECTRIC LIGHT AND POWER.

OTTO, N. Y.—Messrs. Truby Brothers have undertaken to furnish Otto with electric lights and will establish a plant at once.

SAG HARBOR, L. I.—A franchise has been granted to Robert K. Story, of New York, to establish an electric light plant in this place.

CARTHAGE, MO.—The $25,000 bonds issued for the purpose of building an electric light plant in this place have been sold at a good premium.

DYER, TENN.—The Dyer Machine Company is making arrangements to install an electric light plant in this place to meet a long-existing demand for electric lights.

CONSHOHOCKEN, PA.—The American Heat & Light Company has absorbed the Conshohocken Gas Light Company and the Conshohocken Electric Light Company.

CHIPPEWA CITY, WIS.—Mr. C. H. Stanley proposes to establish an electric light plant in this place, where a fine water power is available. A company is already established here.

WASHINGTON, GA.—At the recent election here it was voted to issue $30,000 in bonds for the purpose of purchasing the electric light plant and waterworks system and operating the same under city control.

NEW YORK, N. Y.—The Fisher's Island Electric Light, Heat & Power Company has been chartered in New Jersey to carry on a general electric lighting business at Fisher's Island, N. Y. The capital stock is $10,000.

WHEELING, W. VA.—The Consumers' Electric Company has been organized here with a capital stock of $500,000, by John E. Wright, W. C. Hanlan, Samuel W. Harper, James Steadman, George E. House, all of Wheeling.

SELINS GROVE, PA.—The Selins Grove Electric Light, Heat & Power Company has been organized here with a capital stock of $5000. The incorporators are A. W. Potter, Charles P. Ulrich, and Edwin M. Hummel.

CANTON, PA.—The Canton Illuminating Company has been organized here with a capital stock of $12,000, by L. R. Gleason, H. L. Clark, J. F. Clark, W. V. Bacon, W. C. Sechrist, all of Canton; and Emma M. Lewis, of Washington, Pa.

BRUTUS, N. Y.—The Weedsport Electric Light Company, of Brutus, has been organized with a capital stock of $15,000. The directors for the first year are John D. Edwards, Weedsport; Harrison J. Hoyt and William G. Thorne, Auburn.

CHATEAUGAY, N. Y.—The village trustees have granted a franchise to J. O. Smith, of Plattsburg, to introduce electric lights in this place. Mr. Smith has purchased a water power and proposes to erect a model electric lighting plant.

NEWARK, N. J.—The William Browe & Son Company has been organized in this city with a capital stock of $100,000 to do a general electric light business. The incorporators are Walter L. Browe, George D. Browe, Charles F. Beers and James Perry.

CEDAR RAPIDS, IOWA.—The Iowa City Electric Light Company has commenced to rebuild its plant at Coralville, which was destroyed by fire in February last. The new plant, which, it is expected, will be in running order by July 1, will cost about $18,000.

SENECA FALLS, N. Y.—The Seneca Falls Light & Power Company's property, including the works at Seneca Falls and Waterloo has been sold under foreclosure. Mr. James A. Van Voast, attorney for the General Electric Company, bid the property in for $10,000.

CAMDEN, N. J.—The American Electric Power Company has been organized to make and deal in motive power. The capital stock of the company is $500,000. The incorporators are Charles L. Brown, Abraham L. English, Francis T. Thron, Joseph P. Green and Robert T. Barr.

NEWARK, N. Y.—The recently incorporated light, heat and power company has commenced the building of its new power house. This new company will compete with the Newark Electric Light & Power Company for business in this place. The latter named concern is now in the hands of a receiver.

ALBANY, N. Y.—The Philmont & Claverack Electric Light & Power Company has been incorporated with a capital stock of $10,000 to furnish electric light to the villages of Philmont, Mellenville and Claverack, in Columbia County. The directors are Harry Bates, of Rensselaer; Frank G. Simmons, of Hudson; Ben H. Denison, of Berlin; Charles H. Gardner, of Troy, and Frank Gardner, of North Adams, Mass.

SANTA CRUZ, CAL.—The Big Creek Company has ordered a new electrical plant sufficient to furnish 275-hp, in addition to its present capacity, making a total of 675-hp. This will give the company three different plants. The additional power is necessary because of the demand of the California Powder Company, which alone requires 150-hp. The company furnishes power for the electric railway and lighting system.

WASHINGTON, D. C.—The directors of the United States Electric Lighting Company have elected Mr. O. T. Crosby president in place of Mr. James C. Young, resigned. Mr. Crosby is also president of the Potomac Electric Power Company. He has resigned as president of the City & Suburban Railway Company, and as president of the Georgetown and Tenalleytown Railway Company so that he may be able to give his entire attention to the electric light interests.

PITTSBURG, PA.—Mellon Brothers, local bankers, head the syndicate which has purchased the business and plant of the Homestead Electric Light & Power Company. Transfer has been made. It is stated that the syndicate is about to close negotiations for the purchase of the Braddock, Duquesne, & McKeesport Light & Power companies, and that it is intended to dismantle the plants of the companies absorbed and erect a single plant for the entire system. Power will be furnished to the Monongahela Traction Company.

ST. CLOUD, MINN.—Mr. C. M. Hertig, president of the Benton Power & Traction Company, has asked the city council for permission to compete with the existing water, light and power company in providing light for municipal and domestic purposes and supplying the city with power for manufacturing and other uses. The Benton Company is operating the street railway system of St. Cloud and Sauk Rapids, and it is understood that if it secures the privileges in St. Cloud which have been asked for, the company will develop the Sauk Rapids water power.

THE ELECTRIC RAILWAY.

BORDENTOWN, N. J.—The Monmouth Traction Company intends to extend its trolley line to Allentown, a distance of some eight miles.

DOYLESTOWN, PA.—The Inland Traction Company will build a power house at Souderton for its line between Quakertown and Lansdale.

THE RICHMOND INTERURBAN RAILWAY COMPANY, with a capital stock of $10,000, filed articles of incorporation with the Secretary of State for Indiana on March 23.

XENIA, OHIO.—The electric road between this city and Dayton, projected by J. W. Neff and other Xenia capitalists, is quite certain to be carried through. The company is now advertising for bids on the work of grading.

PADUCAH, KY.—The city has sold the street car franchise to the Paducah Railway & Light Company for $25. The franchise is for twenty years and consolidates all the local street railway and private electric plants.

OTTAWA, ILL.—The City Council has granted a 20-year franchise to the Interurban Electric road, which is to connect Streator, Ottawa and Starved Rock. The Council also extended the franchise of the local company to twenty years.

NEWBURYPORT, MASS.—The Newburyport & Amesbury Railway has been sold at auction by order of the United States Court for the benefit of the stockholders. State Treasurer E. P. Shaw purchased the property, paying therefor $190,000.

WARREN, OHIO.—The Mineral Ridge & Niles Street Railway was sold on March 28 to the Mahoning Electric Railway Company, which operates the lines between this city, Niles and Youngstown. The Mineral Ridge line is about four miles long.

TACOMA, WASH.—The Seattle & Tacoma Electric Railway Company has been incorporated at Seattle by Henry Bucey and H. E. Knatvold, of Tacoma, and John Collins, Charles W. Slater, J. F. Eshelman, George A. Birch and Anthony Corcoran, of Seattle.

CLEVELAND, OHIO.—Plans are being developed for an electric railway between Newcomerstown and Uhrichsville. The right of way has all been secured except three miles. Another trolley line is also planned to run between Massillon and Canal Dover.

DUNKIRK, N. Y.—The City Council has granted an electric railway franchise to Daniel F. Toomey for a period of fifty years. The company will be known as the Dunkirk Electric Railway Company and will have a capital stock of from $150,000 to $200,000.

CLEVELAND, OHIO.—The Cleveland, Wadsworth & Southern Electric Railway Company has been granted a franchise by the County Commissioners to construct an electric railway between Cleveland and Wadsworth. Mr. J. K. Pierson is the promoter of the enterprise.

NORWALK, OHIO.—Some Detroit men were here recently in consultation with local men with regard to building an electric railway from Toledo to Cleveland, via Norwalk. The company desires to secure a site for a power house in this place, and it will be gladly donated.

MUNCIE, IND.—The commissioners of Delaware County have granted a franchise for an electric railway company to run between Muncie and Anderson through to Daleville. Messrs. McCullough and Henry are the promoters. The line will connect with other roads proposed by the same parties.

MANKATO, MINN.—A syndicate of eighteen citizens of this place has applied to the Council for a franchise to construct and operate an electric street car line and a lighting, heating and power plant. It is proposed to eventually extend the railway line to some of the surrounding towns.

HOT SPRINGS, ARK.—The wages of the motormen of the street railway company of this city were advanced to 15 cents an hour on April 1, which is equal to about 10 per cent. increase over their previous pay. The wages of all other employees of the company were also advanced at the same time.

BUFFALO, N. Y.—Joseph J. Churchyard & Co., of this city, have secured the contract to buld an addition to the power house of the Lima & Honeoye Falls Electric Railway Company. The additional equipment will consist of two 150-hp engines to take the place of the gasoline engine recently removed.

HAMILTON, OHIO.—The Cincinnati, Lawrenceburg & Aurora Electric Railway Company, has applied for a franchise in Delhi, Home City, Fernbank, Addystown, North Bend and Cleves, Ohio. It is expected to have the road in operation from Anderson Ferry to the Ohio and Indiana State lines by July 1 next.

DAYTON, OHIO.—The National Traction Company has been organized here to build a line between Columbus and Dayton, and intermediate points. The capital stock of $10,000 and the incorporators are J. Q. A. Coover, A. P. Waymire, F. L. Hutchins, all of Dayton; C. H. Allen and M. C. Reynolds, of Columbus.

KANSAS CITY, MO.—The Central Electric Street Railway Company has filed articles of incorporation, with a capital stock of $2,500,000. Messrs. Daniel P. Holmes, Frank Hagerman and Henry C. Payne are the stockholders. This company will buy out and consolidate the Northeast Electric Railway and the Brooklyn Avenue cable road.

SIOUX CITY, IA.—The properties of the Sioux City Traction Company, the South Sioux City Traction Company and the Sioux City & Leeds Electric Railway Company have been consolidated and negotiations are now pending to include all the other street railway properties in the city. It is stated that a new company will be organized with a capital stock of $750,000.

MILLBURY, MASS.—The Linwood Street Railway Company has been granted a franchise for an electric railway between Linwood and Whitinsville. It is expected to have the line in operation during the coming summer. Connection will be made at Whitinsville with the Worcester & Blackstone Valley Electric Railway, thus giving a through line of 18 miles to Worcester.

NEWPORT NEWS, VA.—The Peninsula Electric Railway Company has closed a contract with the Westinghouse Electric & Manufacturing Company for all the machinery to be installed in its new power house. The company has the right of way on the principal streets and to Old Point, and will compete with the Newport News & Old Point Railway & Electric Company.

RICHMOND, VA.—Mr. J. C. Short, of New York, and associates, have secured a franchise from the Board of Supervisors of Chesterfield County for the construction and operation of an electric railway line between Richmond and Petersburg. The line will be built on the roadway of the old Petersburg turnpike, will be 22 miles long and will carry both passengers and freight.

ST. PAUL, MINN.—There is a proposition on foot to construct a line of electric railway from St. Paul to White Bear Lake. A petition has been presented to the Board of County Commissioners for the right to lay tracks and to run cars along county roads outside the city limits. The gentlemen interested are A. E. Young, C. W. Bunn, Theodore Borup, R. T. O'Connor and Frank B. Howell.

KANSAS CITY, MO.—The Metropolitan Street Railway Company of this city has let two contracts, approximating in amount to $250,000, for the rebuilding of the tracks and overhead construction of the old Northeast electric line running in the northeastern part of the city. The contracts were awarded to the Electrical Installation Company of Chicago for the overhead work, and the Falk Manufacturing Company of Milwaukee, Wis., for the track work.

BROCKTON, MASS.—Work on new trolley line between Brockton and New Bedford will be commenced simultaneously at Bridgewater, Middleboro and New Bedford, and it is hoped to have cars running by July 4. The power

station and car house, which will be located at Lakeville, will be of brick. Two Green-Corliss compound condensing engines of 800-hp each, together with four large boilers, will provide power and the electrical equipment will include two generators of 500-kw capacity each.

GOSHEN, IND.—The Indiana Electric Company, which was organized on March 28, embraces in its management the old Indiana Electric Railway Company, owning the local street car lines in Goshen and Elkhart, the Interurban line between the local liues in South Bend and Mishawaka, the Interurban line known as the South Bend & Mishawaka, and the General Power & Quick Transit Company. The new company is capitalized at $1,000,000, and when the line between Elkhart and Mishawaka is completed the company will have a continuous road from Goshen to South Bend.

LEGAL NOTES.

NOT APPLICABLE TO STREET LINES.—At Denver, Col., April 14, Judge Hallett in the United States Circuit Court refused to grant an injunction to prevent the consolidation of the Denver street railways. The court held that the section of the state contsitution forbidding consolidation of parallel railway lines does not apply to street railways.

LIABILITY FOR DESTRUCTION OF BUILDING.—A valuable residence was destroyed recently in Crawfordsville, Ind., by reason of lightning following a telephone wire attached to said building. Suit is threatened to recover the amount of the loss from the telephone company. No decision of the kind has ever been rendered in Indiana, but the Wisconsin Supreme Court recently held a telephone company liable for causing the destruction of a building by lightning by reason of attaching to it a telephone wire.—Sec. 26, L. R. A. 101.

THE HOPEDALE (MASS.) ELECTRIC COMPANY brought a suit against the Electric Storage Battery Company to recover upon an agreement between the parties, on the 18th of September, 1898, whereby the plaintiff agreed to sell to defendant its letters patent, and also certain land and buildings belonging to plaintiff, together with the cars, machinery, etc., for $160,000. If, upon a competitive test of the two systems, that of the plaintiff was 20 per cent. superior to that of the defendant, the latter company was to pay the further sum of $500,000. Judgment given in favor of the plaintiff on the trial has been reversed by the First Appellate Division, in an opinion by Presiding Justice Van Brunt. The action was brought upon the theory that defendant, having failed to make the test required, the amount provided for under the contract in case such test showed the plaintiff's system was 20 per cent. superior to the defendant's, had become due. The court holds that after defendant had refused to make the test in order to ascertain the degree of superiority, if any existed, plaintiff would have the right to recover damages for that breach of their undertaking, not as money falling due by the terms of the contract, but as damages for defendant's breach of the contract. It was held, therefore, that the demurrer should have been sustained.

PERSONAL NOTES.

MARTIN J. INSULL.

MR. MARTIN J. INSULL has removed from Chicago to New York to assume his new duties in connection with the General Incandescent Arc Light Company, as set forth in these pages last week. He is by education and association with his brother, Mr. Samuel Insull, peculiarly fitted to his sphere of labor and the new lines of business opened up. He began electrical work by being articled in the shops of the Telephone Construction & Maintenance Company in London. Later on he was for four years in the shops of the Edison machine works at Schenectady. He then went to Cornell University, took up mechanical and electrical engineering as a specialty, and after graduation entered into partnership at the age of 24 with the well-known central station designer, Mr. Fred Sargent. For some months past he had been acting as electrical manufacturers' agent in Chicago, in his own name, and the Martin J. Insull Company has now been incorporated in Chicago, to serve as the Western sales agency for the products of the "G. I." Company, and other manufacturing concerns that the Insull name is now connected with so prominently. Other interesting developments are spoken of, and Mr. Insull meantime is organizing the factory work in this city on the large scale necessitated by the demand for the various products of which note has already been made.

MR. W. H. TAPLEY, electrician of the U. S. Printing Office, Washington, was a welcome visitor to New York last week.

PROF. S. H. SHORT, accompanied by Mrs. Short, has just returned from his long stay in Europe, where he has spent several months on pleasure and business bent.

MR. W. J. CLARK, who now has charge of all the foreign business of the General Electric Company, left for Europe last Saturday to attend to a number of affairs awaiting his attention.

MR. A. A. THRESHER, president of the Thresher Electric Company, Dayton, Ohio, has been quite ill for the past four weeks. His many friends trust that his restoration to health may be immediate.

MR. A. M. HUNT, well known from his engineering connection with important Slope electrical plants, is on a brief visit to the East in connection with several plants soon to be placed under construction there.

MR. W. C. WHITNEY, who has done so much to consolidate the traction and lighting interests of New York City, tells the World that he works about three hours a day, and could not live unless he did. He has consolidated 22 street car lines since leaving control of the navy.

MR. JAMES D. REID, the oldest telegraph superintendent in the world, the friend of Morse, the most delightful of companions, and one of the finest Scotchmen who ever made America a home, just been celebrating his eightieth birthday at his native place, Dunfermline, with a game of golf on the Ferry Hills links. Fourscore and foursome go well together in the case of this "grand old man." Long may he drive and put!

Trade and Industrial Notes.

THE WESTERN ELECTRIC COMPANY, Chicago, has just issued its Bulletin, No. 101, illustrating Stanley transformers. The company carries these transformers in stock at Chicago.

THE ROYAL ELECTRIC COMPANY, Peoria, Ill., has just issued an interesting bulletin on inductor generators in which the various types of alternating current dynamos are compared.

MESSRS. BROWNELL & CO., Dayton, Ohio, have closed a contract with the Terminal Company, of Cleveland, Ohio, to supply the boilers for the new station of the latter concern. Messrs. Brownell & Co. report that they are running their works night and day.

MESSRS. F. A. LA ROCHE & CO., 652-660 Hudson Street, New York, have purchased the stock and machinery of the Murphy Switchboard Company, 39 Cortlandt Street. The La Roche Company will conduct the consolidated business under its own management at its present address.

MESSRS. PATTERSON, GOTTFRIED & HUNTER, 146-150 Centre Street, New York, have just issued a colored card illustrating the application of the Reeves wood pulleys, Shaw's compression couplings, Johnson's split collars, Hoppen's adjustable hangers and Page's leather belting.

THE GARVIN MACHINE COMPANY, Spring and Varick Streets, New York, is distributing in the trade a large card giving illustrations of some of the machines sold by it. These include screw machines, engine lathes, planers, shapers, milling machines, foot presses, drill presses, etc.

THE CHASE-SHAWMUT COMPANY has been incorporated at Portland, Me., to manufacture electrical and other machinery. The incorporators are Charles Sprague, Boston; Frank W. Stone, Newton, Mass.; Josiah H. Drummond, Portland, Me., and six others. The capital stock is $300,000.

THE ELECTRIC GAS LIGHTING COMPANY, 195 Devonshire Street, Boston, Mass., has issued a neat little pamphlet illustrating and describing a few specialties in the line of electrical house goods. The list includes electro mechanical gongs, pushbuttons, switches, fire alarm boxes, buzzers, etc.

THE PELTON WATER WHEEL COMPANY has just issued, in the Spanish language, a catalogue of its water wheels. The tables, of which there are many, are reduced to the metric system. The catalogue is very liberally illustrated and includes views of plants which are operated by Pelton wheels.

COLUMBUS, OHIO.—The Interstate Electric Company has been incorporated, with a capital stock of $20,000, for the purpose of engaging in the manufacture of lamps and electrical machinery. Among those interested are Joseph Metzer, Fred Haffner, Martin Koch, John Gotlieb Haffner and Jacob Haffner.

THE ELECTRIC APPLIANCE COMPANY, Chicago, is distributing its 1899 fan motor catalogue, which is a very complete and artistic publication. The catalogue includes a complete list of alternating and direct current desk and ceiling fans together with some other fan specialties. A copy may be obtained on application.

THE COLUMBIA ELECTRICAL SUPPLY COMPANY of New York City has been incorporated with a capital stock of $500,000. The names of the incorporators are Peter C. McPherson, William H. White, Jr., New York City; Thomas P. McGlynn and Harry W. Barkley, Montclair, N. J., and Philip T. Stillman, of Elizabeth.

U. S. METAL POLISH.—Mr. George W. Hoffman, 295 East Washington Street, Indianapolis, Ind., reports that he has just made the third shipment this year of metal polish to foreign countries. Each shipment consisted of a carload. Mr. Hoffman is the sole manufacturer of U. S. Infallible Metal Polish Paste, which is extensively used.

MESSRS. O. HOMMEL & CO., 806 Penn Avenue, Pittsburg, Pa., are manufacturers and importers of bronzing liquids, metal leaf, gold paints, enamels, metal lacquers, etc. As these goods are more or less extensively used in the finishing of electrical apparatus it would no doubt be to the advantage of manufacturers and finishers to look into their merits.

AMERICAN ELECTRICAL SUPPLIES IN ENGLAND.—Mr. Irving P. Favor, 123 West Houston Street, New York, special representative of L. & C. Hardtmuth of Vienna and London, is endeavoring to secure the English agency for high grade American electrical specialties. An opportunity is thus presented to American manufacturers to be represented in London.

MR. FREDERICK PEARCE, of New York, announces that in order to better accommodate his growing business he will on or before May 1 move his office, salesroom and factory to the Metropolitan Realty Building, 18 and 20 Rose Street, and 214-218 William Street, New York. The additional room in the new quarters will enable Mr. Pearce to largely add to his manufacturing facilities.

MONTAUK MULTIPHASE CABLE is being installed for the fire protection of the Jessup & Moore paper mills at Wilmington, Del. Mr. J. W. Aydon, superintendent of the local fire and police telegraph system, is supervising the work of installation. The recent great fires have directed unusual attention to this specialty, which is in great demand as a valuable factor in safety and insurance.

THE KEUFFEL & ESSER COMPANY, 127 Fulton street, New York, carries a very large assortment and stock of drawing and measuring instruments and materials. The company manufactures most of its goods, and controls many of the foreign importations handled by it. Any one in the engineering profession can obtain on application a copy of the company's 400-page catalogue, which is profusely illustrated.

WESTERN ELECTRICAL SUPPLY COMPANY, St. Louis, Mo., is offering to the trade telephone switchboards made by the Western Telephone Construction Company, for which it has recently taken the agency. The Western Electrical Supply Company states that these switchboards are rapidly coming to the front in the large field of competition. The company will be pleased to furnish estimates to any one contemplating the installation of a telephone exchange.

MR. JOHN E. FULLER, the veteran electrical manufacturer, is established at 93 and 95 Maiden Lane, as successor to the North American Electric Company. He will continue to make the well-known battery fan motor, and is now ready for the season's trade. He is also steadily occupied in the construction of telephones, bells, etc., and is meeting with success in all these specialties, due to the experience and knowledge of the wants of the public acquired during an active period of 25 years' work.

MESSRS. J. ELLIOTT SHAW & COMPANY, 632 Arch Street, Philadelphia, Pa., have issued their 1899 catalogue and price list of household and experimental electrical supplies. The catalogue is complete and profusely illustrated, and contains information of a practical character, both in tabular form and text. Several wiring diagrams at the back will be found very useful. The catalogue is provided with a neat cover, the design on which is original and appropriate to the subject.

THE O. S. PLATT MANUFACTURING COMPANY, Bridgeport, Conn., has given to The Smith & Egge Manufacturing Company, of the same place, the exclusive license to manufacture and sell its switches, known in the trade as the "New England Switches." The Smith & Egge Company has added an electrical department to its business, and besides handling the New England switches, it expects to make a line of knife switches. The company may from time to time add other electrical articles to its list of productions.

DISSOLUTION OF PARTNERSHIP.—The partnership heretofore existing between R. L. Whitman and Samuel H. Couch, constituting the firm of Whitman & Couch, 212 Summer Street, Boston, Mass., has been dissolved by mutual consent. The entire plant and business of the old firm has been taken over by Couch & Seeley Company, who will continue the manufacture of telephone apparatus. The new company has increased facilities at its command and will produce apparatus of the highest grade only, maintaining the reputation already established by its product.

PHILADELPHIA MACHINE SCREW WORKS.—Mr. B. Sternberg and W. T. Houston, proprietors of the Philadelphia Machine Screw Works, Philadelphia, Pa., report that they have recently enlarged their plant and have re-equipped it throughout with automatic machinery for making all kinds of special machine screws, electrical appliances and in fact anything turned from solid rod. They are working an extra force until 8 p. m. in order to fill their orders. They desire to call the special attention of the electrical trade to their patent universal adjustable box tool, particulars of which will be sent on application.

THE STERLING VARNISH COMPANY, Pittsburg, Pa., has received a contract from the Union Electric Company, of Berlin, Germany, for 25,000 gallons of electric insulating varnish. The Westinghouse, General Electric and other electrical manufacturing concerns throughout the United States are using a great deal of the Sterling Company's insulating varnish, and the company's export trade is said to be growing rapidly. The company has recently installed a large electric plant to furnish light and power for its works, which are located in Haysville. The material of this company is all made under secret processes.

THE LINCOLN ELECTRIC COMPANY, 71-73 Ontario Street, Cleveland, Ohio, is now building three sizes of horseless carriage motors in which the weight has been reduced to a minimum and the highest efficiency attained. These motors are circular in form, have four salient poles, laminated pole pieces, are of slow speed, and so completely enclosed that they are water tight. They are very light for their capacity, the 2-hp motor weighing 150 lbs., complete. The 1¼-hp motor weighs 100 lbs., and the ¾-hp machine 48 lbs. Some of these motors have been installed on carriages built in Cleveland, and are said to be giving excellent satisfaction.

THE AMERICAN ELECTRIC SPECIALTY COMPANY, 123 Liberty St., New York, reports that the demand is steadily increasing for its direct reading ohmmeter, which was described and illustrated in The Electrical World of Dec. 3, 1898. This instrument possesses the valuable merits of portability and quick reading. It is constructed on the Wheatstone Bridge principle, but does not employ a galvanometer to indicate the balance. In its place a telephone receiver is used. The balance is indicated by the absence of a clicking sound. This method of indicating is superior to the galvanometer method, as it permits of much more rapid work.

THE MILWAUKEE ELECTRIC COMPANY which was recently organized in Milwaukee, Wis., has leased the old Standard Theatre in that city and will at once proceed to fit it up as a factory for the manufacture of dynamos, motors and electrical appliances. The company expects to have its machinery in operation, and 60 men employed by May 1, and it will then go to work immediately on several large orders that have been received. It is capitalized at $40,000, and its officers are: W. P. Harper, president; Walter Cary, vice- vice-president; John A. Whaling, treasurer; H. W. Morris, secretary and chief engineer; James Marshall, superintendent.

THE HAWKEYE ELECTRIC COMPANY, Burlington, Iowa, has purchased the plant of the Sioux City brass works, which has been in the hands of a receiver for some years, and the receiver has been discharged. The Hawkeye company will continue the manufacture and sale of dynamos, motors, telephone switchboards, battery zincs, etc., as carried on by the brass works. It will also do a jobbing business, repairing electrical and other machinery, having a fully equipped plant to carry on such work. The Hawkeye Electric Company conducts an electric lighting business, and will continue the business of the Sioux City brass works under the latter name.

THE DAYTON FAN & MOTOR COMPANY, Dayton, Ohio, is looking forward to a very prosperous fan business during the coming season. Mr. E. O. Waymire, secretary and treasurer of the company, states that the orders are getting ahead of the producing facilities of the company, notwithstanding the fact that it has recently doubled its capacity. The new factory is fitted up throughout with latest improved machinery and is said to be the only one in the country in which alternating and direct-current ceiling fans are manufactured. The company's foreign shipments, Mr. Waymire states, are very heavy. The company has just issued a new catalogue illustrating its ceiling and desk fans.

PIPE COVERING FOR PROTECTION FROM ELECTROLYSIS.—W. R. Weldon, of Fort Wayne, Ind., has invented a covering for underground pipes which he claims will absolutely protect such pipes from the electrolytic action of electric railways. The covering has been tested by A. L. Hadley, of the Fort Wayne Electrical Corporation, who reports that he submitted a sample of the covering seven-eighths of an inch thick to a maximum pressure of 14,000 volts, and that it would require from 20,000 to 25,000 volts to pierce a piece of that thickness. He adds that the material is a good insulator as long as it is kept dry, free from moisture and covered with some paint to render it waterproof.

MESSRS. A. L. IDE & SONS, Springfield, Ill., report 25 recent orders and shipments of "Ideal" engines for driving dynamos and generators. From the list the following are taken: Monterey Electric Light Company, Monterey, Mexico, one 250-hp and one 110-hp tandem compound engines, belted; Emery, Bird, Thayer Dry Goods Company, Kansas City, one 260 hp, direct connected; Kingman Plow Company, Peoria, Ill., one 100-hp, belted; Caro Light & Power Company, Caro, Mich., one 300-hp, belted; Bonham Electric Light Company, Bonham, Texas, one 60-hp, belted; F. W. Horne, Yokohama, Japan, one 45-hp, direct connected; Illinois Central Railroad Company, Chicago, one 80-hp, belted; Deadwood & Delaware Smelting Company, Deadwood, S. Dak., one 100-hp, direct connected; Hillman Building, Chicago, one 125-hp and one 150-hp tandem compound engines, direct connected; Illinois State Reformatory, Pontiac, Ill., one 200-hp, belted; Lancaster Electric Light Company, Lancaster, Wis., one 100-hp, belted; Anheuser-Busch Brewing Association, two 125-hp, direct connected; Chicago & Great Western Railroad, for shops at Oelwein, one 180-hp and one 300-hp, direct connected; City of Barnesville, Minn., one 60-hp, direct connected; Empire Zinc Company, Joplin, Mo., one 150-hp and one 100-hp, direct connected; Mississippi River Commission, two 500-hp tandem compound engines; W. J. Lemp Brewing Company, St. Louis, two 100-hp and one 60-hp, direct connected.

Record of Electrical Patents.

UNITED STATES PATENTS, ISSUED APRIL 11, 1899.

[In charge of W. A. Rosenbaum, 177 Times Building, New York.]

622,657. CIRCUIT BREAKER; Hjalmar Emanuel Andersson, of Stockholm, Sweden. App. filed Feb. 14, 1898. (See Current News and Notes.)

622,669. BATTERY CUT-OUT FOR ELECTRIC SELECTOR SYSTEMS; T. C. Drake, Malta, Ohio. App. filed Feb. 17, 1898. The operating battery is cut in and out by making and breaking contacts on an escape wheel through the instrumentality of a supplemental relay.

622,747. SPLICER FOR TROLLEY OR OTHER WIRES; W. M. Wood, Chicago, Ill. App. filed Nov. 2, 1898. The two ends of the wire are each covered by a cap having a conical exterior, the caps taking firm hold of the ends of the wire; the joint is then surrounded by a sleeve having a tapering interior so that the tendency of the wires to pull apart increases the grip of the caps upon the wire and so holds the wires within the surrounding sleeve.

622,748. RHEOSTAT; W. H. Woodman, San Francisco, Cal. App. filed Nov. 17, 1898. The resistance wires are strung like a harp, and to prevent short circuiting when they are expanded by heat, there is provided an expansible frame which is normally compressed by the tension of the wires, but which expands automatically to maintain such tension when any part of the resistance becomes heated.

622,759. ELECTRIC ARC-FORMING DEVICE; Josef Czikowski, of Vienna, Austria. App. filed Nov. 29, 1898. (See Current News and Notes.)

622,778. CABLE SUPPORT; W. A. Nordyke, Indianapolis, Ind. App. filed Aug. 3, 1898. To support the cables where they pass through the manhole, uprights with adjustable brackets thereon are fixed in the manhole.

622,813. TROLLEY; Silas T. Leaming, Jr., of Wanwatosa, Wis. App. filed Aug. 16, 1897. (See Current News and Notes.)

622,865. APPARATUS FOR LINE DISTRIBUTION BY INDUCTIONAL TRANSFORMERS OR SECONDARY GENERATORS FOR ELEC-

TRIC RAILWAYS; Elias E. Ries, of Baltimore, Md. App. filed Dec. 30, 1887. (See Current News and Notes.)

622,866. SYSTEM OF ELECTRICAL DISTRIBUTION; Charles F. Scott, of Pittsburg, Pa. App. filed Nov. 4, 1898. (See Current News and Notes.)

622,885. CIRCUIT BREAKER; Harry P. Davis, of Pittsburg, Pa. App. filed Nov. 4, 1898. (See Current News and Notes.)

622,917. ELECTRIC TEMPERATURE INDICATOR; J. H. Dorion, Springfield, Mass. App. filed May 31, 1898. An alarm device giving two signals, one when the normal temperature is slightly exceeded and the other when the temperature rises to the danger point. The operation depends upon the fusing of two connections having melting points at different positions upon the thermometric scale.

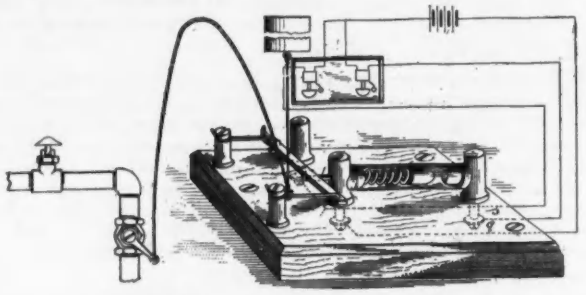
622,919. ELECTRICAL ILLUMINATED ADVERTISING SIGN; W. T. Bell, Nottingham, Eng. App. filed Feb. 2, 1898. The invention embodies a switchboard provided with a series of depressible contact pins, one for each lamp on the sign; a jacquard pattern card having apertures registering with various numbers of the pins. A carrier provided with apertures registering with all of the pins, moves the pattern toward and away from the switchboard.

622,922. METHOD OF AND APPARATUS FOR ADMINISTERING THERAPEUTIC ELECTRICITY; W. P. Horton, Jr., of Cleveland, Ohio. App. filed Dec. 5, 1898. The apparatus involves the necessary devices for administering a high potential induced current and a low potential continuous current, simultaneously, with means for regulating each.

622,977. ELECTRICAL STEERING MECHANISM; Andrew L. Riker, of New York. App. filed May 23, 1898. (See Current News and Notes.)

622,991. TROLLEY; Robert E. Carroll, of Lima, Ohio. App. filed Nov. 19, 1898. (See Current News and Notes.)

623,006. FLEXIBLE ELECTRICAL CONDUCTOR; J. W. Gottschalk, Philadelphia, Pa. App. filed Feb. 8, 1899. A braided conducting cord made in continuous lengths, having enlargements at intervals formed by increasing the thickness of the covering. The cord is intended to be used on central station switchboards, and the thickened portions occur at the point where the cable is handled most.



No. 622,917.—Electric Temperature Indicator.

623,009. FIRE ALARM; H. E. Green and J. W. Haley, Hot Springs, Ark. App. filed Jan. 3, 1899. The invention relates to the construction of the case enclosing the mechanism for turning in an alarm. The lower part of the case has a glass panel in its front which is to be broken to gain access to a push button inside.

623,022. ELECTRIC CATHETER; R. P. Johnson, Chicago, Ill. App. filed March 30, 1898. A helical conducting wire is inserted in the instrument for the stated purpose of conveying an electric current to any desired part of the accessible passages of the body and to discharge it through the liquid introduced into or contained in the part treated and thereby so diffuse it that a large current may be used without discomfort to the patient.

623,033. LIGHTNING CONDUCTOR; G. Rannacher, Vienna, Austria. App. filed Jan. 20, 1899. The rod terminates in a sphere surrounded by a plurality of points. It is stated that the electricity accumulates in great quantities on the spherical surface and thus increases the absorbing power of the conductor.

623,036. CARBON SORTING MACHINE; C. T. Richmond and N. N. Zelers, Cleveland, Ohio. App. filed March 26, 1898. The essential features of the machine consist of a broken electric circuit, a rotary chuck connected with one terminal and adapted to grasp one end of each of the carbons to be tested and to rotate the same upon its axis, and a contact-plate connected with the other terminal and held in such relation to the carbon in the grasp of the chuck that it will be touched at some period in its rotation by every carbon which is too crooked, and by no others, thereby completing the electric circuit.

623,063. APPARATUS FOR RECORDING ELECTRIC CURRENTS; Herman Aron, of Berlin, Germany. App. filed Jan. 17, 1899. (See Current News and Notes.)

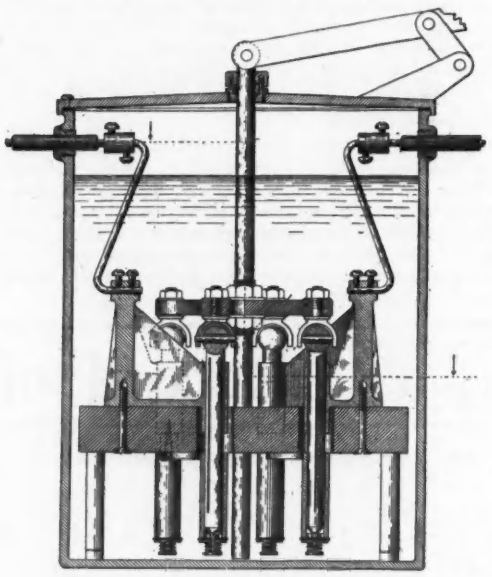
623,104. ELECTRODE FOR ELECTRIC ACCUMULATORS; H. Pieper, Jr., Liege, Belgium. App. filed Dec. 28, 1897. The electrode is so constructed as to uniformly distribute the liquid through its body. It is built up of radially corrugated plates having the shape of hollow truncated cones, open at the top and bottom, and plain plates of like shape, one kind alternating with the other.

623,117. LISTENING KEY OR CIRCUIT CHANGER FOR OPERATORS' KEY BOARDS; J. Baxten, Ft. Wayne, Ind. App. filed April 25, 1898. A slide carries a member movable with respect to it; contacts are suitably arranged so that in the movement of the slide one circuit is made and in the movement of the member carried by it, another circuit is made.

623,118. SWITCHING APPARATUS; J. Cloos, Milwaukee, Wis. App. filed Feb. 7, 1898. Consists of an oscillating lever with plugs suspended thereon and a base plate supporting at its upper and lower portions thimbles which are adapted to be engaged.

No. 623,033.—Lightning Conductor.

623,119. SWITCHING APPARATUS; J. Cloos, Milwaukee, Wis. App. filed Feb. 7, 1898. The apparatus consists of terminals for the feeders and loop-circuit, a conducting portion, means for connecting the conducting portion with all of said terminals at the same time, switch parts for connecting the feeder-terminals with the loop-terminals in series, the whole apparatus being constructed to permit of the connection of the loop-terminals with and disconnection of said terminals from the feeder-terminals while said portion is serving to connect the feeder terminals.



No. 623,120.—Switching Apparatus and Method of Counteracting Arcs.

623,120. SWITCHING APPARATUS AND METHOD OF COUNTERACTING ARCS; J. Cloos, Milwaukee, Wis. App. filed Feb. 7, 1898. The invention consists of a reciprocating support to which a number of plugs are flexibly connected, and a base upon which thimbles are mounted, the apparatus being immersed in oil. Means are also provided for producing a vacuum upon breaking the circuit, the oil being drawn into the vacuum as the contact parts separate, whereby arcs are prevented.

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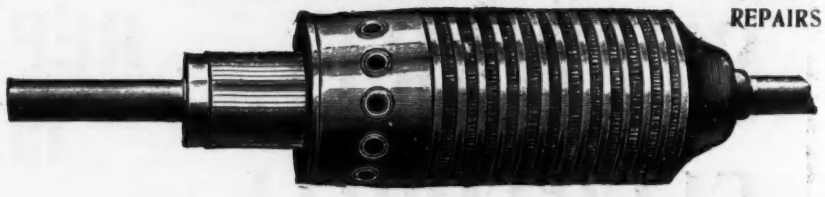

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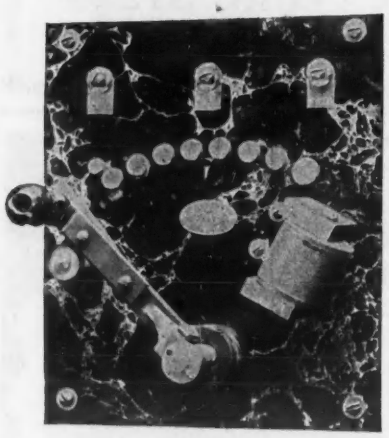

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